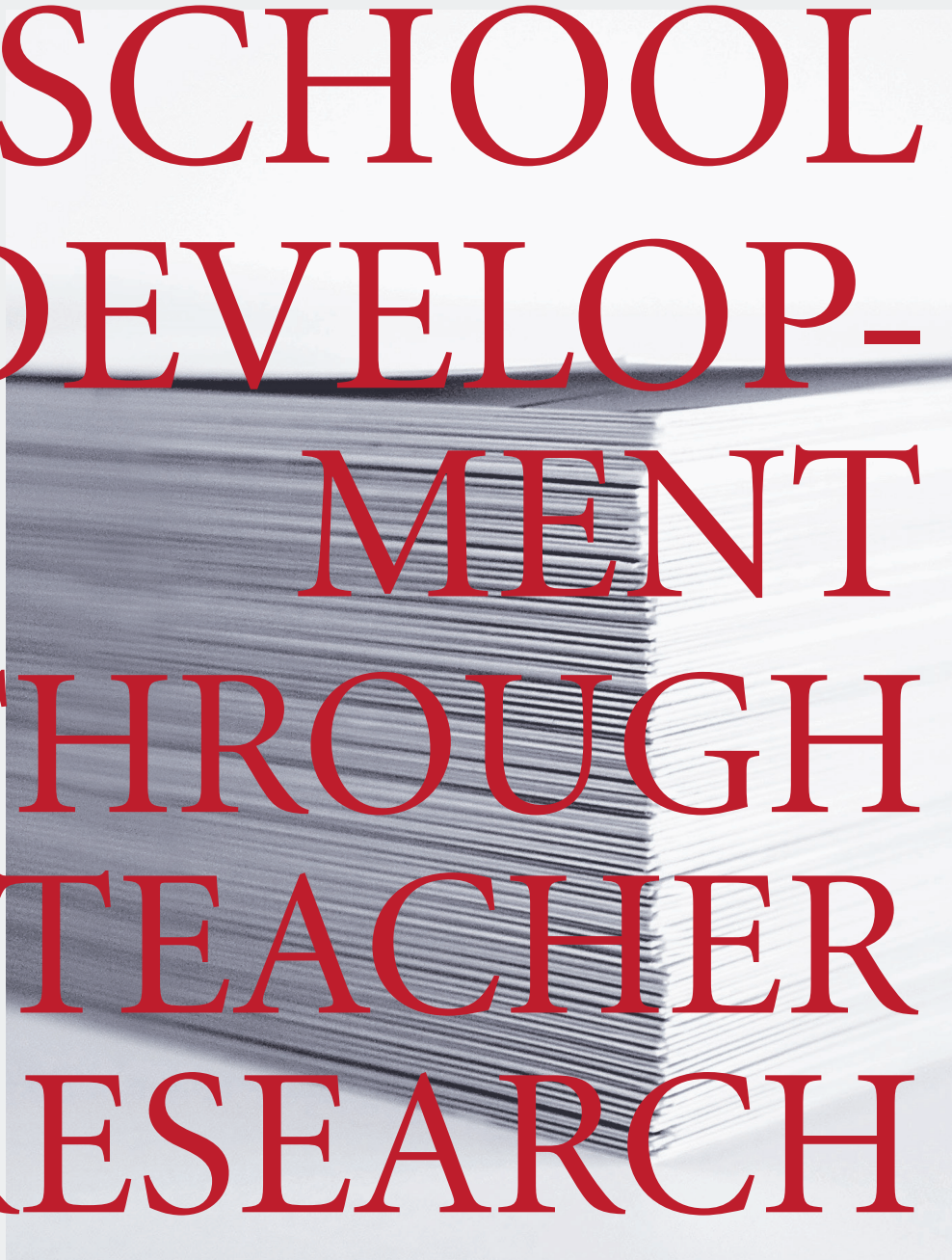


Edited by Inger Eriksson & Kalafunja Osaki



SCHOOL DEVELOP- MENT THROUGH TEACHER RESEARCH

Lesson & Learning Studies
in Sweden and Tanzania

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School Development Through Teacher Research

Lesson and Learning Studies in Sweden
and Tanzania

Edited by
Inger Eriksson & Kalafunja Osaki



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Foreword

The origination of this project lies with Dr Gunilla Höjlund, who since the beginning of the 1990s has been involved in different cooperative projects between researchers in Tanzania and Sweden. Thanks to her experiences and connections to different researchers at the University of Dodoma (UDOM), and her interest in school development, the Tanzanian-Swedish research team was brought together. The Swedish team, from Stockholm University (SU), and especially Professor Ingrid Carlgren, have since the beginning of 2000 worked with the models of Lesson and Learning Studies (LLS) and Professor Kalafunja Osaki who has experience of Lesson Study as part of his collaboration with researchers in Japan. Further, the Swedish government has a long tradition of funding collaboration with researches in Tanzania. Professor Osaki and I made an application to the Swedish research program, Research Links, run by the Swedish Council for Research on behalf of the Swedish Authority for Development Cooperation. The application was approved in November 2012. The founding we got covered expenses for travels and meetings to be used over the period 2013 to 2015.

The idea for the proposed project was to use Lesson and/or Learning Study as a model for research based school development. Or more precisely, as models to enhance teaching -learning in relation to different subjects. The project was centred on local cases in four different subject areas in the respective countries. In Tanzania the four cases were conducted within the established cooperation between UDOM and single municipality primary schools, and in Sweden within the established cooperation between the SU and schools in the municipalities in the Stockholm area.

The research group at UDOM consisted of Professor Kalafunja Osaki¹ (co-project leader), Dr Andrew Binde, Dr Noah Mtana² and Dr Francis William. All Tanzanian researchers had a position at UDOM when the project started. The research group from SU consisted from the start of four researchers: Professor Inger Eriksson (co-project leader), Professor Ingrid Carlgren, Dr Gunilla Höjlund and Dr Viveca Lindberg³. During the second year of the project Dr Åsa Hirsh⁴ from Jönköping University joined the Swedish research group.

In Tanzania four postgraduate-students were enrolled as research assistants to function as mentors to the teachers in the four schools. In the Science case PhD student Festo Nguru participated, in the Mathematics case PhD student Ayoub Sanga participated, in the cookery case MA. Flora Mbembe participated and in the English case PhD student Geoffrey Murasi participated. In Sweden one of the researchers or a research assistant supported the participating teachers of each case and also supported the teachers in writing the cases. Two PhD students Charlotta Andersson and Jane Tuominen financed by the local administrative authority, Norrtälje Municipality supported the Science case. Professor Eriksson supported the Mathematics case and Dr Lindberg supported the cookery case. PhD student Jessica Berggren, financed by the local administrative authority City of Stockholm, supported the English case.

Table 1. Participating Schools, Teachers and Their Mentors in Respective Country

	Country	School	Grade/ students	Participating teachers	Tutor
Science	Tanzania	Kaloleni Primary School	6/74 students	Ms Irene Makule, Ms Mary Chigarula, Ms Joyce Ikanga, Mr Zephania Issack and Ms Dominatha Benjamin	Dr Francis William & Festo Nguru (PhD student)
	Sweden	Hallsta Primary School	6 & 7/ 80 students	Mr Roger Axelsson, Ms Ulrika Gustafsson, Ms Helen Karlsson, Ms Camilla Weiler	Charlotta Andersson (PhD student) & Jane Tuominen (PhD student)

¹ Professor Osaki has moved to St Augustine University of Tanzania.
² During the project Dr Mtana got a position at Jordan University College in Morogoro, in Tanzania.
³ Today Dr Lindberg has a position at the University of Gothenburg.
⁴ Today Dr Hirsh has a position at the University of Gothenburg.

	Country	School	Grade/ students	Participating teachers	Tutor
Mathematics	Tanzania	Makole Primary School	6/62 students	Ms Happiness Sam, Mr Ayoub Seif; Ms Robi Nyamhanga; Ms Ignasia Masinde.	Dr Andrew Binde & Ayoub Sanga (PhD student)
	Sweden	Nya Elementar Primary School	6/50 students	Ms Kristina Edner, Ms Sara Fransson, Ms Christina Lidgren, Mr Per Westin	Prof. Inger Eriksson
Cookery/ Home and Consumer Studies	Tanzania	Makulu Primary School	6/30 students	Mr Jackson Lameck, Ms Hellen Bunyinyiga, Ms Nyamtondo Wanjara, Ms Habiba Chuwurah	Prof. Kalafunja Osaki & Flora Mbembe (MA student)
	Sweden	Maria Primary School & Sofia Primary School	6/60 students	Ms Carole Pardue & Ms Eva Mårtensson	Dr Viveca Lindberg
English	Tanzania	Mnadani Primary School	6/120 students	Ms Neema Shemangare, Ms Rehema Nkungu, Ms Asha Ramadhani	Dr Noah Mtana & Geoffrey Murasi (PhD student)
	Sweden	Hässelbygård Primary School	7 /57 students	Ms Helena Hedqvist, Ms Annika Håkansson, Ms Pernilla Kronestedt, Ms Anna Palmer	Jessica Berggren (PhD student)

In the following, the project, and especially the eight cases, will be presented. In order to frame the cases, as an introduction, a background and the models of Lesson and Learning Study (LLS) are given. As editors we want to express our gratitude to Dr Gunilla Höjlund and Professor Ingrid Carlgren's for persistent work with the manuscript; reading, correcting and commenting on each chapter repeated times.

We want to address a special thank you to participating teachers and mentors of the research group (see Table 1 above). Without your work the whole project would not have been possible, the cases would not have been written and this book would not have reached the readers.

This book is written to support teachers and other educators' wishing to reflect about learning and the struggle of learners to discern various concepts, principles and practices, as well as those who genuinely wish to see learning take place, rather than simply seeing content 'covered' – including teacher educators, curriculum developers, educational researchers, and students of pedagogy and didactics. We dedicate this

to those who seriously are concerned about more effective learning and understanding in different subject areas.

Inger Eriksson. *Stockholm, 15 January 2018*

Kalafunja Osaki. *Dar es-Salaam, 15 January 2018*

About the Authors

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Andrew Binde, (PhD), Co-Director of the project titled 'Capacity Development for Mathematics teachers in Rural and Remote Communities in Tanzania under University of Dodoma (UDOM) and UAlberta Agreement. Former Dean, School of Curriculum and Teacher Education and teaching courses in Educational Research, supervision of PhD/Masters students' dissertations/thesis and MES students under UDOM/UAlberta Agreement as Adjunct Professor. Recently, engaged by Stockholm University (SPIDER) to make a Follow up of implementation of a project titled "Enhancing Early Grade Literacy and Numeracy Using Digital Content in selected Nyarugusu

Refugee Camp Primary Schools (NRCPSs) in Kigoma Tanzania. Occasionally, have been serving as internal/External Examiner for Masters Students including St. John's University Dodoma (2014/2015). Awarded Certificate Outstanding Performance for Academic staff by the University of Dodoma (May 2015).

Ingrid Carlgren, professor in Education at Stockholm University and former vice Chancellor at Stockholm Institute of Education. Her research interests are: curriculum and cultures of knowledge, teachers' professional knowledge and clinical research approaches. Recent publication: *Kunskapskulturer och undervisningspraktiker* (Cultures of knowledge and teaching practices), Daidalos 2015; *Undervisningsutvecklande forskning* (Teaching Development Research) Gleerups 2017; Carlgren, I. (2012). The Learning Study as an approach for 'clinical' subject matter didactic research. *International Journal for Lesson and Learning Studies*, 1(2), 1-18. Carlgren, I., Ahlstrand, P., Björkholm, E. & Nyberg, G. (2015). The meaning of knowing what is to be known. *Education & Didactiques*, 9(1).

Inger Eriksson, professor in Education at Stockholm University. Her research interest is related to teaching and learning. In earlier research projects, her focus has been on the learning that is made available in classrooms, given different teaching practices and in relation to that she has developed an interest in Lesson and Learning Study as a collaborative research approach. Most of her research is related to mathematics. Recent publication: Eriksson, I., & Jansson, A. (2017). Designing algebraic tasks for 7-year-old students – a pilot project inspired by Davydov's learning activity. *International Journal for Mathematics Teaching and Learning* 18(2); Eriksson, I. & Lindberg, V. (2016). Enriching learning activity with epistemic practices – enhancing students' epistemic agency and authority. *NordSTEP* 2016, 2.

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Gunilla Höjlund, (PhD), has retired from the Stockholm University, Department of Education. Her research interest has mainly focused on Vocational Education and skills formation in formal and informal settings. She has many years of experiences of working in Tanzania in the field of education at all levels from primary to tertiary education including vocational education and has co-edited a publication on teaching and learning in primary education and on practice and possibilities in teacher education respectively. Her special interest is local school development, teacher professional development and institutional development. Other countries of work include Lao PDR and Pakistan.

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His research interest concerns learning in science and environmental education, pedagogy, didactical and classroom studies, curriculum analysis, design, and development, developmental research and Lesson Study. He has edited two books with proceedings of conferences in Science and mathematics Education in Southern Africa, and is completing a book on Curriculum design and development issues in the African environment and another on Environmental Education. He has supervised several students and published extensively on curriculum analysis, curriculum development and implementation, concept development in basic science, environmental education, professional development of teachers and pedagogy and developmental, classroom based studies.

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PART ONE

LESSON AND LEARNING STUDIES AS TOOLS FOR SCHOOL DEVELOPMENT IN TANZANIA AND SWEDEN

CHAPTER 1

Framing the Research Project – Background, Aim and Project Description

Inger Eriksson & Kalafunja Osaki

The three year long research project, here reported, draws on cooperation between educational researchers from Tanzania and Sweden.¹ Even though the country contexts differ in social, economic as well as educational conditions and state of teacher education and classroom standards, many recurrent education challenges are shared. These include the tendency to make educational reforms with little or no input from professionals. In both countries a number of costly reform decisions have been taken without substantially improving learning or teaching. Both countries struggle with students' weak (in Tanzania) or declining (in Sweden) results nationally and internationally. They thus share a corresponding concern for how to improve education quality. Further, in both countries new outcomes based curricula have been implemented. These new curricula put a much higher responsibility on teachers; teachers must be able to organize teaching that enables all students to develop required abilities/competences. Thus, teachers need tools to develop knowledge that can contribute to their professional knowledge base.

¹ The project that started in January 2013 was financed by the Swedish research program, Research Links, run by the Swedish Council for Research on behalf of the Swedish Authority for Development Cooperation. The financing covered expenses for travel and meetings. The schools or the municipality have financed the different cases.

The Overarching Aim of the Lesson and Learning Study Project

Lesson Study has seen a worldwide spread as a model for school development focusing on developing teachers' professional culture. Experiences from the US point at some difficulties in implementing the Lesson Study model in a country with top-down governance through centrally produced reforms; this concerns also the Learning Study being a more complex and research based model.

With an overall interest in issues of teaching and action research the aim of this collaborative project was to examine and further develop Lesson and Learning Study (LLS)² as models for developing and improving the quality of teaching and learning in schools (the models are further described in Chapter 3), thereby allowing schools to reach higher goal fulfilment. An additional aim was to analyse different prerequisites and barriers to LLS as models for teacher owned school development (see Chapter 2).

The Lesson and Learning Study Project and the Research Team

The research project was realised through four case studies in each country with a focus on students' development of specific capabilities and values (object of learning, see Chapter 3) in different subjects. The four parallel cases were conducted in Grades 6-7 within Science, Mathematics, English as second language and Vocational Skills/Home and Consumer Studies. Initially, the idea was that the two parallel cases in Tanzania and Sweden should have focused on the same object of learning, but when comparing syllabuses and discussing with teachers it was clear that this was only partly possible. In the syllabuses for Science and Mathematics the content and the expected learning outcomes resembled each other to some degree and the Swedish teachers tried to match the content that the Tanzanian teachers had chosen. In Science the content concerned matter and its states and in Mathematics fractions. English as a second language in both countries differs to a rather high degree as do the students everyday experiences of English. In Tanzania the content was reported speech while the content in Sweden was storytelling. Finally, the content and expected learning outcomes in the Tanzanian syllabuses for Vocational Skills and the Swedish syllabuses

² Sometimes the abbreviation LLS is used, especially when we want to address similarities of two models. In each case we use either Lesson or Learning Study depending on the model used.

for Home and Consumer Studies differ substantially (see part two). In Tanzania the content concerned baking bread while in Sweden it was about choosing appropriate tools for preparing food.

In Tanzania the four cases were conducted within the established cooperation between the University of Dodoma (UDOM) and single municipality primary schools, and in Sweden within the established cooperation between Stockholm University (SU) and municipalities in the Stockholm area.

Workshops as a Tool for Collaboration

The work of the research group was organised in form of four weeklong joint workshops, alternating the venue between the countries. During the workshops the researchers visited schools, analysed and compared curricula, syllabuses and teaching materials. The last year the researchers presented their work at a conference in South Africa.³ Complementary meetings with the schools and teachers were organised locally in the two countries respectively.

The design of the studies has, to a large extent, followed the ways in which Lesson and Learning Study respectively are ‘normally’ carried out, i.e. as a cyclical process involving planning, analysis and revision of a single lesson (further described in Chapter 2). The data generated includes: recorded meetings of various discussions, video recorded lessons, photos, pre- and post-test data from students, teaching materials, and interviews with head teachers and teachers.

The Outline of the Book

The project and its findings reported in this book give priority to the different cases. The book is divided into three parts. The first part is made up of three chapters. Chapter 1 aims to frame the cases. Following this chapter, Chapter 2 gives a more in-depth description of Lesson Study and Learning Study and the related key concepts: *object of learning* and *critical aspects*. Chapter 3 concerns issues related to the function of different types of pre- and post-test that are regularly used in Learning Study as a way to analyse students actual knowing.

Part two presents the cases. An introductory general comparison between the two countries’ curriculum and school system is given in Chapter 4. Following this comparison the cases are presented. Each

³ The SAERA 2015 Conference, University of the Free State, Bloemfontein Campus, 27 to 30 October 2015.

subject's specific cases are framed by a common introduction followed by a curriculum description. Chapter 5 presents the two Science cases, Chapter 6 presents the two cases of Vocational Skills and Home and Consumer Studies. In Chapter 7 the two cases in English are presented. Chapter 8 presents the two cases in Mathematics.

Part three is divided into two chapters. Chapter 9 provides a meta-analysis of the cases and the schools in Tanzania (9.1) and Sweden (9.2) respectively. A concluding discussion on Lesson and Learning Study as models for school development is presented in Chapter 10.

The different chapters are written by different authors; meaning language use and structure vary from chapter to chapter and each chapter is more or less possible to read as a freestanding text.

CHAPTER 2

Lesson and Learning Study

Ingrid Carlgren

Lesson Study has its roots in the Japanese education system (Yoshida & Fernandez, 2004) and refers to what in Japan is called *Jugyuu kenkyuu*, which means instructional improvement through teachers coming together to create effective lessons and examine their own practices. The concept Lesson Study was introduced to an international audience through Stigler & Hiebert's book "The Teaching Gap" (1999) as a way to achieve instructional improvement as well as teachers' professional development.⁴ Since the students in several Asian countries, among them Japan, performed much better in Mathematics and Science, a follow up-study in order to find out whether the differences could be explained by teaching methods and instructional forms, was carried out. The teaching of Mathematics in Grade 8 in Germany (middle performing country), Japan (high performing country) and the U.S. (low performing country) was observed and comparatively analysed. In this comparison the Japanese teaching stood out in terms of high student involvement and activity in combination with a strong focus on the mathematical content. In contrast the German case was characterized by high focus on content but low student activity and involvement and the US case by high student

⁴ The title of the book refers to the title of another book, "The Learning Gap" (Stevenson & Stigler, 1992), in which differences in performance in international mathematics and science tests between Asian and Western students were dealt with.

involvement and interaction but a low focus on the mathematical content. In the German case the level of teaching was advanced. The teachers were leading the students through the mathematical content and the student exercises were focused on technical mastery. The teaching in the U.S. was less advanced. Teachers gave definitions and demonstrated mathematical solutions, which were expected to be practiced by the students in follow-up exercises. In contrast to both other cases the Japanese lessons were well structured with high level of student activity and the teachers seemingly in the background. Discussions and evaluations of student solutions to mathematical problems were common.

Stigler & Hiebert (1999) related these differences in teaching cultures to the Japanese Lesson Study tradition. Compared to the Western tradition of centrally initiated, top down educational reforms, Japanese teachers have been much more involved in instructional improvement and school development when the national curriculum is revised. While the Western tradition of centrally launched reforms to be implemented in schools has a long history of failure, the Japanese tradition seemed to be much more successful in terms of teachers' professional development and instructional improvement.

To summarize: the argument in the Teaching Gap was that differences in achievement could be explained by differences in teaching cultures, which, in turn, could be explained by differences in models for school and professional development. Since then educators have credited Lesson Study with bringing about Japan's effective mathematics and science teaching (Lewis, 2002).

Learning Study was developed in Hong Kong around 2000 within the frame of a large research project, "Catering for individual differences" which was launched in connection with an education reform (Cheng & Lo, 2013; Lo, 2009). Learning Study combined elements from the Lesson Study with the so called *variation theory* of learning which was used as an explicit theoretical framework to guide, analyse and evaluate the teaching and learning processes (Marton & Pang, 2006; Marton, 2015). The Learning Study has a narrower focus than the Lesson Study. Its focus is always on the intended learning, the so-called *object of learning*. Besides, the Learning Study is always informed by an explicit learning theory. So far, this has almost exclusively been the variation theory, which is used as design principle as well as a tool for analysing teaching and learning.

There are several common features in Lesson and Learning Study. As a matter of fact Learning Study is a kind of Lesson Study. In both a group of teachers work together with instructional improvement through a process of goal setting, research lesson planning, data collection and revision. While Lesson Study may or may not be guided by a learning theory, Learning Study is always guided by a learning theory.

In the following I will start by giving a brief outline of Lesson and Learning Study as different researchers have described them. Thereafter they will be described in relation to the themes of *school* and *professional development* as well as an approach for carrying out educational research.

The Japanese Lesson Study Tradition

Lesson Study, or *Jugyou kenkyuu*, as a key factor in the development of teaching and teacher competencies in Japan has a long history. Classroom visits occurred on a regular basis from as early as 1872 (Arani, 2017).

The core of Lesson Study is teachers' collaborative development of a lesson with a special purpose. The process involves collaboration in setting the goals for what they want to bring about and making a lesson plan in such a way that it is possible to reach these goals. This plan also includes an account of the motives and arguments behind the tangible arrangements. Through expounding the meaning of the intended outcome and why a certain arrangement would accomplish that, the research lesson is given a theoretical description. One teacher runs the lesson while the others observe what happens in the class. The observations generally include detailed narrative records of the learning of several students – different team members may observe and collect detailed data concerning selected students who typify particular challenges for the teachers.

Thereafter the lesson is analysed and evaluated in the light of the observations. The process of the research lesson may be analysed in terms of different lesson segments (e.g. introduction, development, turn, conclusion) (Arani, 2017:14). The plan is revised and another teacher conducts the revised lesson in another class and so on. The research lesson is documented to make it possible for teachers who have not participated in the work to share the lesson (Yoshida, 1999; Lewis, 2009; Yoshida & Fernandez, 2004).

The stages of Lesson Study as described by Stigler and Hiebert (1999:112-116) are:

1. Defining the problem
2. Planning the lesson
3. Teaching and observing the lesson
4. Evaluating the lesson and reflecting on its effect
5. Revising the lesson
6. Teaching the revised lesson
7. Evaluating and reflecting a second time
8. Sharing the results

During Lesson Study teachers formulate long-term goals for student learning and development. They then collaboratively work on “research lessons” to bring these goals to life. The long-term goals for student development include what kind of persons the school want them to become. The research lesson is about a problematic topic, which also addresses the broader theme. The single lesson is thereby placed in a context and long-term perspective. In that way a connection between long-term goals and daily practices is established, leading to a double focus on long-term goals and the immediate lesson.

A very important aspect of Lesson Study is *Kyouzai kenkyuu*, which according to Elliott (2017) can be interpreted as the analysis of curriculum materials that are used to realise curricular standards and aims in the classroom. Arani (2017) has a more straightforward way of putting it: *the study of teaching materials*. Sometimes the abbreviation LLS is used, especially when we want to address similarities of two models. In each case we use either Lesson or Learning Study depending on the model used.

Lesson Study in Japan is most often part of a highly structured, school-wide (sometimes district-wide) project – involving all of a school’s staff and aiming at addressing a common teaching-learning challenge (Takahashi & McDougal, 2016). It plays a critical role in the implementation of revisions in the national curriculum across the country.

Japanese teachers participate in Lesson Study every now and then⁵ but they can also get access to lesson designs in written forms or in the form of a public lesson i.e. a lesson that is open for other teachers to

⁵ According to Lewis et. al. (2004) the average teacher in Japan participates in around 10 research lessons a year.

observe. In that way instructional improvement is not confined to the local school but stored and shared with others.

Learning Study

A research group at the University of Hong Kong and at the Hong Kong Institute of Education developed the Learning Study model.⁶ According to Marton and Runesson (2015) the idea was publicly presented for the first time in a lecture on November 27, 2001.

We took the Japanese Lesson study as our point of departure, but introduced a particular theory of learning developed mainly in Sweden over several decades, and elaborated further in Hong Kong (Marton & Booth, 1997; Marton & Tsui, 2004), as a basis for our work, as well as systematic pre- and post-tests, aiming at publishable forms of reporting. (Marton & Runesson 2015, p.103)

Learning Study has been described as combining the Japanese Lesson Study and design experiment (Brown, 1992). This is because, as in design experiments, theoretical design principles are systematically involved in the process. However in a Learning Study the teachers “own” the problem setting as well as the development of the teaching design. The learning theory is used by the teachers as a tool in their collaborative design work. As previously mentioned an important facet is the primacy of the content of that which is to be learnt, which is called *the object of learning*. Learning Study is thus an inquiry into the classroom practice from the point of view of learning something specific. In contrast to educational objectives, which are the same for a certain age group, the object of learning is relative to the learners so that it changes according to what the learners already know (Marton & Runesson, 2015).

So the object of learning is that which the students have not yet learned, but which is necessary for attaining particular educational objectives. These are aspects of the educational objectives that are usually not very obvious. They are called *critical aspects* since they are necessary to discern in order to grasp the object of learning.

All aspects of an object of learning are not critical – and they are not critical to all students. Therefore a distinction can be made between potential and actual critical aspects. Potential critical aspects are the component parts of the object of learning and actual critical aspects

⁶ Ference Marton, Lo Mun Ling, Pong Wing Yan, Pakey Chik Pui Man and several others. Ference Marton was a visiting professor at the University of Hong Kong, on leave from the University of Gothenburg, Sweden.

refer to those aspects that students have not discerned and have to learn to discern.

Another defining feature of Learning Study is the explicit theoretical framework, which so far has mainly been variation theory (Marton & Tsui, 2004). The most important idea of variation theory is that learning is a function of discernment and discernment is a function of variation. Students must experience a certain pattern of variation and invariance to be able to discern something specific and therefore teachers should, by creating patterns of variation, help students to discern the critical aspects that are identified for the specific object of learning.

Variation theory states that differences in learning (the same thing) are due to differences in discerning critical aspects of the object of learning. To make learning possible, these critical aspects must be made possible to experience as dimensions of variation. Therefore, teachers should identify critical aspects of the object of learning and then structure patterns of variation in order to allow students to discern those aspects. If the teacher, for example, wants the students to discern a certain colour or shape this aspect can be made discernable through creating contrasts to other shapes and colours to make them appear as dimensions of variation.

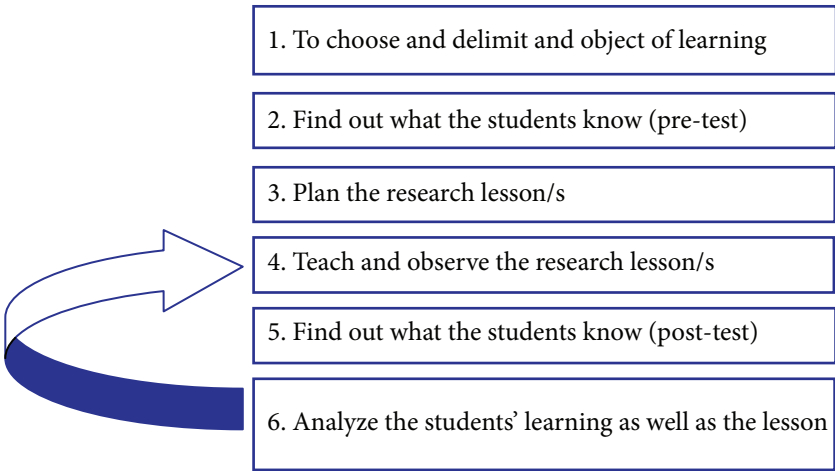
According to variation theory it is the patterns of differences and similarities between examples, illustrations, and problems etc. that make learning possible or not possible. It is through such patterns that the learners might or might not discern the critical aspects of the object of learning. A central idea in variation theory is that when introducing new meanings or new concepts, the focus should be on differences, rather than sameness.

It is, however, important to note that what the teacher is supposed to do in the classroom does not follow mechanically from the theory. Rather it is the principles of variation theory that function as a tool for teachers in planning and analysing the processes.

The Learning Study-process

Just like in Lesson Study the Learning Study is carried out in an iterative process with cycles of planning, teaching, analysis/reflection and revision of the plan. The planning stage includes choosing the topic, defining the object of learning and identifying critical aspects of this object.

Figure 1. The Cyclical, Iterative Process in Learning Study



Source: Carlgren, Eriksson & Runesson, 2017

1. To choose and delimit an object of learning

The starting point in a Learning Study is most often something that is difficult for students to learn or for teachers to teach. This “something” is formulated as an object of learning, a specific content that the student is expected to know in a certain way. The object of learning can also be formulated in relation to some new aspect of the national curriculum.

To understand what it is that produces the difficulties for students or teachers the existing practice is first scrutinized: How do we normally teach this? What are our experiences of student difficulties, etc? To widen the perspectives the national curriculum as well as other texts and research articles are studied.

When formulating and delimiting the object of learning a first interpretation of its meaning is accomplished, i.e.: What is it that someone who knows this object of learning knows and how is it expressed in speech and actions? What specific ways of handling the tools characterize someone who knows the object of learning?

In this step teachers’ subject matter knowledge is very important. However, even teachers with solid subject matter knowledge have difficulties when trying to define the meaning of knowing that which is expected to be known (Carlgren, et al. 2015).

2. Find out what the students already know (pre-test)

Based on discussions and analyses in the first step assumptions regarding potential critical aspects of the object of learning are

formulated, i.e. a specification of what the students must discern in order to acquire the object of learning. These preliminary formulations are used to find out what the students already know regarding the object of learning as well as what they have to learn, i.e. which aspects are critical to discern for this specific group of students. This is called a “pre-test” – although the aim is diagnostic and formative. Sometimes certain tasks from, for example, national tests may be used but often new tasks are designed in order to make the students pre-knowings visible (see Chapter 3). These tasks should have a form, which will make it possible to analyse the answers qualitatively. It is not the number of correct answers that are of interest but how the students have motivated their answers as well as the implicit thinking involved in the answers.

Sometimes the students are interviewed to follow up their answers. Sometimes these interviews are transcribed and thoroughly analysed in order to map different ways of thinking and acting among the students.

The construction and analysis of the pre-test leads to a first specification of the object of learning. This process of specification continues all the way through the Learning Study.

3. Planning the research lesson/s
Based on the analysis of the pre-test and guided by the theoretical perspective and design principles from the learning theory the research lesson is planned. It may be certain tasks to try out or a lesson. In contrast to the planning teachers normally do, this planning focus on the content – how to bring out critical aspects of the object of learning and make it possible for the students to grasp. When using variation theory the focus is very much on how the critical aspects can appear for the students – e.g. what kinds of contrasts are needed in order to make the critical aspect visible.
4. The research lesson
One of the teachers teaches the research lesson while the others observe. The lesson is also often video-documented. It is important to plan in advance what should be observed in order to get relevant data for the analysis of the lesson. The focus should be on how the content is treated – i.e. how different aspects of the object of learning are brought out and made possible to discern.
5. Find out what the students know after the lesson (post-test).
Some time after the research lesson the students get a “post-test” in order to provide indications of whether they have discerned

the assumed critical aspects. It may also be that other aspects and dimensions must be put in the forefront. The post-test may be the same as the pre-test. Sometimes there is a delayed post-test given to the students a couple of weeks later.

It is important to be cautious when using differences in the results between the pre- and post-test as evidence about the effect concerning the development of student knowing. The “tests” are most often tentative and often it is not until after the Learning Study is finished that it becomes clear what questions should have been asked in the tests. It is not unusual that several weaknesses of the pre-test are discovered during the Learning Study process (see Chapter 3).

6. Analysis of the lesson in terms of student learning – and revision. The results of the pre- and post-tests are analysed in relation to the video-documented lesson (partly or wholly transcribed) leading to assumptions about what should be changed in order to improve the lesson: Have the learning difficulties been solved? Do the students seem to have developed the kind of knowing that was planned? If not – why? Do we have to revise our assumptions and how must the teaching be changed?

Lesson and Learning Study as School Development

Lesson Study has been described as a local route to *school development* in which the classroom becomes the teachers’ laboratory for continuous improvement of teaching and learning (Lewis, 2002). The most common form of Lesson Study takes place within a single school as a school-based professional development program. Often the purpose is to seek practical ideas for implementation of the Japanese national curriculum (Murata & Takahashi, 2002). Although most often the Lesson Study is school-based and framed within the local school development it may also be that a whole district of schools are involved.

Lewis, Perry and Hurd (2004) discuss the success of Lesson Study in the article “*A deeper look at Lesson Study*”. Apart from what is obvious, namely the improved quality of available lesson plans and an increased knowledge of instruction, they point out an increased knowledge of subject matter among the participating teachers that is embedded in the lesson plan. Lesson Study also leads to stronger collegial networks – it can help build a community of practice in which teachers routinely share resources and ideas. They develop a common frame of references and experiences leading to stronger connections of daily practices to long-

term goals. Further, Lesson Study increases the teachers' motivation and sense of efficacy. Normally it is difficult as a teacher to get feedback regarding the actual effect of the teaching. Through the systematic observation and reflection teachers may develop a more conscious sense of teaching and learning.

These pathways to development can be seen in Learning Study as well. There is, however, a more narrow focus on exploring the "what" of learning through connecting teaching and learning to specific objects of learning which are scrutinized and dissected rather than connecting the daily practices to long-term goals. But it has been shown that there are effects beyond the specific object of learning – regarding teachers' teaching as well as students' learning (Cheng & Lo, 2013).

Learning Study was developed as a model for instructional improvement regarding individual differences and has been evaluated in terms of effects on student learning. It has been shown that especially weak students gain from this (Elliott, 2012; Holmqvist et al. 2007; Kullberg, 2010). Hundreds of Learning Studies carried out in different projects at Hong Kong Institute of Education were found to improve student learning, reduce the gap between high and low achievers, and contribute to teachers' professional development (Lo et. al. 2005).

One of the strengths of LLS as models for school development is that they deal with problems identified by the teachers, and when changes in the national curriculum are to be implemented. By clarifying and incorporating teachers' individual beliefs and values in the process they get around a common barrier to improvement.

Lesson and Learning Study as a Way to Professional Development

To see LLS as *professional development* implies a focus on teachers' competencies and learning. LLS processes are consistent with what researchers have suggested are effective for teacher professional development, namely a collaborative inquiry centred on classroom instruction through the four activities: planning, observing, analysing student learning, and revising instruction.

Participating in LLS makes it possible for teachers to develop different kinds of capabilities and competences. Teachers develop their subject matter knowledge as well as a capability to observe students and see the teaching activities from the students' point of view. Through the LLS process they become aware of what seems to create difficulties for their students. They also engage in making explicit what often are tacit

aspects of teaching and learning, for example, what it means to know a specific object of learning. Much of what teachers learn during Lesson Study applies to areas beyond the particular lesson and subject matter.

However, professional development is not only about enhancing the competencies of individual teachers. LLS contribute to the collective development of a professional ‘body of knowledge’ to be shared with others as well as stored and communicated – in the form of public lessons, written documents and case study descriptions. Since the Lesson Study tradition includes structures for sharing and communicating the results of the efforts at regional and national levels it is well suited not only for development work in the classroom but also for spreading of good examples as well as ideas about teaching and learning.

Studies from Hong Kong and Sweden have shown how teachers participating in Learning Study benefit from working collaboratively. Teachers acquire a language for talking about and analysing teaching and learning together. They also develop a greater awareness of students’ prior experiences and the possible difficulties they may encounter in any object of learning and thereby an enhanced capability to diagnose the gap between the intended object of learning and students’ conception of it. An increased confidence in handling individual differences in class is also reported (Lo & Marton, 2012).

The process of teachers’ learning to connect subjects matter to student learning has been described by Florin Sädholm (2015). The process goes from taking the subject matter for granted to gradually problematize it in relation to student learning.

Lesson and Learning Study as an Approach to Research on Teaching, Learning and Knowing

Besides being a way to professional as well as school development, LLS are also seen as approaches to *research on teaching and learning* in the classroom. Knowledge is generated when teachers work together to improve a lesson through designing and revising research lessons. In contrast to traditional university-based research, the improvement process coincides with the research process. Thereby LLS may be regarded as belonging to the family of design and development research approaches (Van der Akker, 1999; Van der Akker et. al. 2006) although with a stronger focus on teachers’ perspectives and consequently in many respects similar to action and teacher research approaches (Zeichner & Noffke, 2001). These are, to a large extent, owned by the teachers. Other designations for LLS as research approaches could be

engineering research (Sensevy et. al. 2013), *clinical educational research* (Carlgren, 2012; Toulmin, 2001) or *improvement science* (Stigler & Hiebert, 2016).

LLS as research have a double focus: the aim is improving teaching with regard to a specific learning target and at the same time producing knowledge of a more general kind about teaching and learning.

An important aspect of this kind of research is that teachers' professional (and often tacit) knowledge is integrated into the research activities and in the generation of new knowledge. Thereby the research object as well as research results will be easily integrated in the body of professional knowledge. Since it is the teachers who design the means, their familiarity and acquaintance with the teaching situation will guarantee the usability of the designs. By involving teachers' tacit knowledge in the development of designs, results will probably become more sustainable and relevant than what is normally the case in educational research and developmental work.

The usability of results does not, however, mean that the results can be applied mechanically. The knowledge is generated in dynamic, interpretative and meaning-making practices and is intended for use in other dynamic, interpretative and meaning-making practices. Knowledge generated in a Learning Study can be shared, as a basis for another Learning Study. However, teachers themselves have to try to find the critical aspects in each particular case, document their findings and by doing so collectively build a stock of potential critical aspects.

Lesson Study as Collaborative Lesson Research

Lesson Study has been described as an approach to transform teachers' craft knowledge (to a large extent tacit) into a professional knowledge base i.e. making it public, sharable, storable and verifiable as well as improved (Hiebert et. al. 2002). However, Lesson Study has existed in Japan for more than a century and has evolved as cultural practice embedded in the Japanese school culture. The level of success of attempts to adapt the practice of *Jugyuu kenkyuu* to cultures and institutional contexts in other countries has varied widely. According to Stigler and Hiebert (2016: 582) this may be explained by a superficial adoption of Lesson Study focusing on the developed lesson plan that is most visible from the outside while, at the same time, missing the point: to understand the teaching practice as an object for examination and improvement. The true nature of Lesson Study is – so to say – lost in translation. Lesson Study is a research process intended to produce

knowledge on the part of teachers that can be applied in their future teaching. So, a library of lessons is not the primary goal although as Morris & Hiebert (2011) have pointed out – such a library could be a way to store professional knowledge for teaching.

Against the background of a failure to establish Lesson Study in the sense of the deeper meaning that it has in Japan, Takahashi and McDougal (2016) have developed what they call a powerful form of Lesson Study: *Collaborative Lesson Research* (CLR) with an emphasis on:

1. A clear research purpose – CLR as research with a focus on searching for a solution to a teaching-learning problem. Although it is about a specific topic the research goal goes beyond the particular topic.
2. *Kyouzai kenkyuu* – the careful study of academic content and teaching materials.
3. A written research proposal – based on *kyouzai kenkyuu* and to explain their instructional thinking, i.e. a rationale for the design.
4. A live research lesson and discussion – requires observation from different viewpoints – which cannot be substituted by video.
5. Knowledgeable others – in the planning as well as the post-lesson discussion.
6. Sharing of results.

Learning Study as Research

Although each Learning Study is organized around the creation of one or several lessons in relation to a specific object of learning, the research object may vary. Depending on the kind of research questions we can discern three kinds of Learning Study as research:

1. Learning Study as *effect research* focusing on teachers' and/or students' learning. In this kind of research the impact of Learning Study on teaching as well as student learning is studied. Studying the differences between pre- and post-tests is an important aspect.
2. Learning Study as *teaching and learning research* focuses on how teaching can be designed in order to enhance learning of specific objects of learning. Research questions are normally about how the teaching creates opportunities for student to learn a specific object of learning e.g. through the pattern of variance/invariance regarding critical aspects of the object of learning. They may also be about identifying the critical aspects of the object of learning for different student groups. Studying the relation between teaching designs and the learning that takes place is important here.

3. Learning Study as *unpacking the object of learning* focuses on exploring the meaning of the object of learning, i.e. that which is expected to be known. The object of learning may be described as a triadic relation between the known, the knowing and the knower(s). It includes not only what should be known but also the knowing of this as well as different ways of knowing within the specific student group. In this kind of Learning Study all steps in the cycle are used to explore the meaning of the object of learning; the pre-test as well as the research lessons produce important data to analyse.

Concluding: Lesson or Learning Study?

As previously pointed out, Learning Study is a kind of Lesson Study, which means that it is sometimes difficult to separate the two approaches. However, the main difference is the foundation on a theory of learning (mostly variation theory) together with a focus on the object of learning within the former. In both it is the teaching-learning relationship that is researched – but from different perspectives. While the Learning Study is more focused on the object of learning, Lesson Study emphasizes the lesson as part of a larger puzzle, which must be seen in a long-term perspective. Learning Study focuses the *what* of learning while Lesson Study often emphasizes the *how*.

References

- Arani, M. (2017). Raising the quality of teaching through Kyouzai Kenkyuu – the study of teaching materials. *International Journal for Lesson and Learning studies*, 6(1), 10-36.
- Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, 2(2), 141-178.
- Carlgren, I. (2012). The learning study as an approach for 'clinical' subject matter didactic research. *International Journal for Lesson and Learning Studies*, 1(2), 1-18.
- Carlgren, I., Ahlstrand, P., Björkholm, E. & Nyberg, G. (2015). The meaning of knowing what is to be known. *Education & Didactique*, 9(1), 143-160
- Carlgren, I., Eriksson, I. & Runesson, U. (2017). Learning study [in Swedish]. In I. Carlgren (Ed.) *Undervisningsutvecklande forskning. Exemplet Learning Study*. Gleerups, Lund.
- Cheng, E. & Lo, M. L. (2013). *Learning Study: Its Origins, Operationalisation, and Implications*. Education working paper no 94. OECD, Directorate for education.

- Elliott, J. (2012). Developing a science of teaching through lesson study, *International Journal for Lesson and Learning Studies*, 1(2), 108-125. <https://doi-org.ezp.sub.su.se/10.1108/20468251211224163>
- Elliott, J. (2017). Editorial review. Lesson study as curriculum analysis (Kyouzai Kenkyuu) in action and the role of “the teacher as researcher”. *International journal for lesson and learning studies*, 6(1), 2-9.
- Florin Sädöbom, R. (2015). *I det didaktiska spänningsfältet mellan styrning och elevers lärande: En studie av lärares tal om och iscensättning av kursplanemål i en mål- och resultatstyrd skola* [In an era of restructuring the educational system in Sweden, didactic tension between managing by objectives and student learning, in Swedish]. Dissertations Series No. 31. Diss., Jönköping University.
- Hiebert, J., Gallimore, R. & Stigler, J.W. (2002). A knowledge base for the teaching profession: What would it look like and how can we get one? *Educational Researcher* 31(5), 3-15.
- Holmqvist, M., Gustavsson, L. & Wernberg, A. (2007). Generative learning. Learning beyond the learning situation *Educational action research* 15(2), 181-208.
- Kullberg, A. (2010). *What is taught and what is learned? Professional insights gained and shared by teachers of mathematics*. Göteborg Studies in Educational Sciences 293. Göteborg: Acta Universitatis Gothoburgensis.
- Lewis, C. (2002). *Lesson Study: A handbook of teacher-led instructional change*. Philadelphia, PA: Research for Better Schools.
- Lewis, C., Perry, R. & Hurd, J. (2004). A deeper look at Lesson study. *Educational Leadership*, February 2004:18-22.
- Lewis, C. (2009). What is the nature of knowledge development in lesson study?, *Educational Action Research*, 17(1), 95-110, DOI: 10.1080/09650790802667477
- Lo, M.L. (2009). The Development of the Learning Study Approach in Classroom Research. *Hong Kong Educational Research Journal* 《教育研究學報》 24(1), Hong Kong Educational Research Association 2009.
- Lo, M.L. & Marton, F. (2012). Towards a science of the art of teaching. Using variation theory as a guiding principle of pedagogical design. *International Journal for lesson and learning studies*, 1(1), 7-22.
- Lo, M.L., Pong, W.Y. & Chik, P. (Eds). (2005). *For each and every one. Catering for individual differences through learning study*. Hong Kong: Hong Kong University Press.
- Marton, F. (2015). *Necessary conditions of learning*. New York, NY: Routledge.
- Marton, F. & Pang, M.F. (2006). On some necessary conditions of learning. *Journal of the Learning Sciences*, 15(2), 193-220.
- Marton, F. & Runesson, U. (2015). The idea and practice of learning study. In K. Wood & S. Sithampram (Eds), *Realising learning. Teachers' professional development through lesson study and learning study*. New York: Routledge, 103-121.

- Marton, F. & Tsui, A.B.M. (2004). *Classroom discourse and the space of learning*. Lawrence Erlbaum, Mahwah, NJ.
- Morris, A.K. & Hiebert, J. (2011). Creating shared instructional products an alternative approach to improving teaching. *Educational Researcher* 40(1), 5-14.
- Murata, A. & Takahashi, A. (2002). *Vehicle To Connect Theory, Research, and Practice: How Teacher Thinking Changes in District-Level Lesson Study in Japan*. In: Proceedings of the Annual Meeting [of the] North American Chapter of the International Group for the Psychology of Mathematics Education (24th, Athens, GA, October 26-29, 2002). Volumes 1-4; <http://files.eric.ed.gov/fulltext/ED471780.pdf>
- Sensevy, G., Forest, D. Quilio, S. & Morales, G. (2013). Cooperative engineering as a specific design-based research. *ZDM Mathematics education*, 45(7), 1031–1043.
- Stevenson, H. & Stigler, J.W. (1992). *Learning gap: Why our schools are failing and what we can learn from Japanese and Chinese education*. New York: Simon & Schuster.
- Stigler, J. & Hiebert, J. (1999). *The teaching gap. Best ideas from the World's teachers for improving education in the classroom*. The Free Press, N.Y.
- Stigler, J. & Hiebert, J. (2016). Lesson study, improvement, and the importing of cultural routines. *ZDM Mathematics Education*, 48(4), 581-587.
- Takahashi, A. & McDougal, T. (2016). Collaborative lesson research: maximizing the impact of lesson study. *ZDM Mathematics Education*, 48(4), 513-526.
- Toulmin, S. (2001). *Return to Reason*. Harvard University Press.
- Van den Akker, J. (1999). Principles and Methods of Development Research. I J. van den Akker (Ed.), *Tools in education and training*. Boston, N.Y. Kluwer Academic, 1–14.
- Van den Akker, J., Gravemeijer, K, McKenney, S.& Nieveen, N. (Eds) (2006). *Educational design research*. London: Routledge.
- Yoshida, M. (1999). *Lesson study: A case study of a Japanese approach to improving instruction through school-based teacher development*. Doctoral diss., University of Chicago
- Yoshida, M & Fernandez, C. (2004). *Lesson study: A case of a Japanese approach to improving instruction through school-based teacher development*. Mahwah, NJ: Lawrence Erlbaum.
- Zeichner, K. & Noffke, S. (2001). Practitioner research. In V. Richardson (Ed.), *Handbook of research on teaching*. 4 Edition. AERA, 2001.

CHAPTER 3

Exploring Students' Knowing by Pre- and Post-tests in Lesson and Learning Studies

Viveca Lindberg, Åsa Hirsh & Andrew Binde

Introduction

In Learning Studies, as well as in other types of intervention studies, pre- and post-tests are often used to get an input value of students' knowledge, as well as a learning outcome value after a certain intervention is performed. According to Pang and Marton (2003), one of the five steps of a Learning Study is

Ascertaining students' pre-understandings, by an analysis of students' conceptions or a pre-lesson test on their capability. This also helps planning the research lesson(s) with respect to the different ways of experiencing the object of learning. (p. 177)

Carlgren (2012) identifies the use of pre- and post-tests in Learning Studies as one of the aspects that indicates "comparing effects in terms of pre- and post-test differences" (ibid. p. 11). The importance of pre- and post-tests is regularly emphasised as an essential ingredient in publications on Learning Studies.

However, how these tests are constructed with regards to content validity, and for what purpose they have been used seems to vary between studies, from traditional paper and pen tests to structured or

semi-structured interviews, observations, children's note books, etc. This calls for a more systematic review. The purpose of this chapter is to problematize and discuss such tests as method for exploring students' learning and as point of departure for specifying the object of learning and identifying possible critical aspects. Since research groups in this project have explored cases of Lesson and Learning Studies in Tanzania and Sweden, we have limited the review to Swedish and Tanzanian Learning Studies on doctoral level in order to explore

- what kinds of pre- and post-tests have been used in the studies?
- what has been the function of the pre- and post-tests in the studies?
- issues of validity related to the types of 'tests' used and their functions.

The theses chosen fall in the period 2005-2015, starting with the first thesis on Learning Study published in Sweden 2005. In the following, we will briefly show the different ways in which *ascertaining students' pre-understandings* have been addressed in international articles on Learning Studies, before we elaborate on the Swedish and Tanzanian theses.

On Pre- and Post-tests in Lesson and Learning Studies

Since some kind of pre- and post-test is seen mainly as part of the process in Learning Studies, we start with these and end with examples from Lesson Studies. In a recent article Pang and Marton (2017, p. 339) emphasize the importance of teachers and researchers knowing "students' existing understanding of the object of learning (through a test or interview)". In contrast to the above mentioned concepts: pre- and post-tests, in this article the term *evaluation* has been chosen: "The lesson is preceded by an evaluation [...] and ends with an evaluation of the extent to which they have mastered the object of learning after participating in the lesson." This change of terms is interesting, but it should be noted that they, in their above quoted article from 2003, mention pre-test as an alternative. Few authors in internationally published articles on Learning Study seem to have paid attention to the issue of the tests. In the following we use some examples⁷ to concretise why we find it important to address the types of tests/evaluations used as well as their function.

⁷ All examples used in this part have been chosen from the International Journal for Lesson and Learning Studies to ensure they are representative within this field of research. They were chosen based on a search within this journal, using *test* as keyword for the search. This resulted in 118 titles that mentioned test during the period. Of these, five are editorials, six are conceptual papers, 54 are research papers and 35 concerned Lesson Studies.

An article by Lung Tang and Wah Leung (2012) represent one type of study that includes pre- and post-test in their design. Here the purpose is “to compare the learning effectiveness” (p. 262). The information about the test is that: “The content of the pre- and post-tests was identical, except for the sequence of questions” (p. 265). Translations of the test are included as appendices to the article, but the authors leave it to the reader to judge the validity of the test used. Similar to these, several articles give no further information about test-construction or issues of validity. In other articles, authors reveal somewhat more about the test construction, for instance that curricular goals or prescribed content have been used for test construction. Such articles seem unaware of the importance of information about test construction – how the object of learning has been operationalized.

However, there are also articles that identify new possibilities and propose new meanings for Learning Studies. Nyberg and Holmqvist (2015) acknowledge the potential of Learning Studies as a means to work with formative assessment. They suggest that formative assessment needs a theoretical framework and that variation theory could be such a theory and also be used for formative assessment. Their argument for choosing variation theory is that it is the most commonly used theory in Learning Studies (Marton, 2015; Marton & Pang, 2006; see also Chapter 3). Further, Nyberg and Holmqvist (2015) emphasize that “it is only if the result from the assessment is used to inform teaching and learning that it can be said to have a formative function” (p. 54). The authors thereby contribute to the body of research that deliberately focuses on the double information that lies in formative assessment, feedback to teachers’ teaching and students’ learning (Sadler, 1989). One of the points they make is that the aim of assessment in Learning Studies

is to make in-depth microanalyses of the students’ learning in order to identify what the critical aspects of the content in question are in relation to the learners, and how these aspects can be made discernible in a powerful way. (Nyberg & Holmqvist, 2015, p. 58)

These authors also provide some further information about the test construction process, but very little of the test is revealed in the article:

The object of learning is initially chosen by the teachers and defined in detail after a screening, an interview or test to assess students’ pre-knowledge, which identifies the aspects that may be critical for learning. A pretest is thereafter constructed based on the results of the initial screening and guided by the chosen theory of learning, in this case, variation theory. (Ibid. p. 60)

Pre- and post-tests were also used in several of the reviewed research articles related to Lesson Studies. As above, some only briefly mentioned that they administrated a test (cf. Bradshaw & Hazell, 2017), while others were more explicit – for example Adulyasas and Rahmann (2014) used a test (van Hiele) explicitly developed for measuring levels of geometrical thinking, as the pre- and post-test for measuring effects of the Lesson Study regarding students' learning.

In summary, although some articles mention pre- and post-tests, or some kind of evaluation of students' knowledge or conceptions preceding Learning or Lesson Studies, few authors explicitly elaborate on how these tests/evaluations have been operationalized or discuss possible validity problems. With this introduction we proceed to the Swedish and Tanzanian theses, in order to explore how these issues have been addressed in them.

Swedish and Tanzanian Theses

For this review, one Tanzanian and 25 Swedish theses were found.⁸ Some of the theses are built on more than one Learning Study. The Tanzanian thesis and most of the Swedish theses are monographs, the others are article-based theses with commentaries, which means that nationally and/or internationally published articles are part of the thesis. For this chapter, the review focuses only on issues related to the object of learning, how the issue of pre- and post-test/evaluation has been addressed, and the purposes of the pre- and post-test/evaluation.

Methodology for Analysis of Types of Tests and their Function

Each thesis was read in relation to (i) the object(s) of learning; (ii) the information about pre-test or similar concepts (e.g. diagnose/mapping of students' prior knowledge) as well as the post-tests; and (iii) the purpose or function of these. In some theses, the purpose of the tests was explicitly stated whereas in other theses this information was implicit and was identified by interpreting the information given.

In the next step, these descriptions were read comparatively, in order to find similarities and differences, which was used for categorisation of types of pre- and post-tests on the one hand, and functions of these on the other.

⁸ For the Swedish theses, the data-base www.diva-portal.org was used. The Tanzanian thesis was found through Google scholar.

Findings – Descriptions of Pre- and Post-tests in the Theses

Mathematics was the most frequent school subject in focus of Learning Studies; four of the Swedish theses as well as the Tanzanian thesis involved teachers in mathematics, teaching young students (9-10 year olds), secondary school (15-16 year olds) and upper secondary school (16+). None of these studies addressed the same or related objects of learning.

Mathematics

For all Learning Studies on mathematics, paper-and-pencil tests were used. Oltenau (2007) describes that she (as the researcher) constructed the pre-test administrated to the students, based on the national syllabus for mathematics. The purpose of this test was diagnostic. The chosen objects of learning concerned: arithmetic, algebra, geometry, function theory. Each item in the test was tested by item-analysis for consistency with curricular goals. Furthermore analyses for reliability and validity were performed. These paper-and-pencil tests were further complemented by individual interviews with each student based on his/her test, with the purpose of mapping students' conceptions of the mathematical concepts in focus. The participating teachers constructed two follow-up tests based on curricular goals. The purpose of these was to control students' learning. Students that accepted participating in a further study also took a post-test that was constructed based on what they needed to improve, and a following interview based on their test. Here the purpose was to explore participating students' experiences of the object of learning.

Wernberg (2009) formulated pre- and post-tests for each object of learning in the three sub-studies in accordance with regular school tests using well-established test items. In other words: she based the tests on cultural mathematical traditions. The objects of learning were (i) discerning differences in time; (ii) rounding decimals correctly; and (iii) discerning the equals sign as relational and static. Students were of the age 9-10. The test-items in the pre- and post-tests were similar but not same. When the tests were tried out, teachers and researcher found they were too long. Therefore, a shorter delayed post-test with core items for the object of learning was given. The paper-and-pencil tests were complemented with individual video-recorded interviews with students, based on their answers in the test. The purposes of the tests were firstly to map students' reasoning about and arguments for their answers, and

secondly to identify critical aspects. Specific for Wernberg's thesis is that she suggests that in Learning Studies these tests should be understood as expressions of the formative purpose of assessment, since such pre- and post-tests can be used for elicitation of students' understanding of the object of learning and thereby give indications of critical aspects. This information can then be used for redesigning teaching, which, as mentioned, is an important aspect of formative assessment.

In Kullberg's (2010) thesis little information is given about the tests, except that the pre- and post-tests used were identical. However, based on indications and references it was possible to trace a previous work where parts of the tests for one of the two Learning Studies included in her thesis were presented. In her master's thesis Kullberg (2004) writes that the test was intended to measure students' (12-13 year olds) knowledge of the density of rational numbers and was constructed by the research team at that occasion. One of the test items was presented for further analysis. The other test items were not presented as she found them less relevant for her study, a comment that could be taken as an indication of validity problems, which would have been valuable information to share with others. When it comes to the second Learning Study, the object of learning is addition and subtraction of negative numbers. There is an earlier published version also of this study, however not accessible electronically, thus further information of this test is not available for our analysis. According to her thesis, Kullberg (2010) analysed quantitatively the post-tests, calculating the effect size, based on students' results for the pre- and post-tests. Furthermore, this analysis was complemented by a qualitative analysis of video recordings of teaching, focusing on which of the critical aspects the teaching made possible for students to learn in relation to students' results on post-test. Together, these analyses of the tests and the video-recorded lessons contributed to identifying students' varying ways of experiencing the object of learning on the one hand, and gave indications of the impact of teaching and changes in students' understanding on the other.

The Tanzanian thesis (Msonde, 2011) has a double focus in that he studied three groups of students – for each of them different objects of learning were chosen – and simultaneously introduced a learner centred approach for the teachers to implement for these Learning Studies. Students included in the studies attend secondary school, Grade II or III. The objects of learning were (i) the relationship of sides of a right triangle and trigonometric ratios; (ii) students' understanding of the slope of straight lines; and (iii) students' understanding the determinants

of arc length of circular objects. For each of these, pre-test and post-test in the form of paper-and-pencil tests were administered. Some of the test items as well as some of students' solutions are presented in the thesis as well as in appendices. No information about considerations for test items included in the test/operationalization of the three objects of learning is given. Test results were used for measuring differences before and after research lessons and a statistical testing of the significance of the differences. No reflections related to the tests used were included.

Paper- and pencil tests were also used in Mårtensson's (2015) study. She constructed the tests on the basis of hypotheses of critical aspects of each of the two objects of learning of her study. The first object of learning was related to division of numbers between 0 and 1, focusing on students' understanding of why the quotient in division can become bigger than the numerator. The second object of learning was students' understanding of different forms of representation of the constants k and m in the linear equation $y = kx + m$. Mårtensson constructed the tests guided by a handbook in mathematics on the one hand, and Swedish diagnostic tasks for grades 6-9. Information is given about the types of items included and the whole test is in an appendix to the thesis. The purpose of the pre-test was to identify students' varying ways of experiencing the object of learning. The post-test was complemented with interviews of eight students. The interviews are based on each student's test. The questions asked in the interviews focused on clarifications of how students understood the object of learning with the purpose of finding indications of the impact of teaching and changes in students' understanding of the object of learning. Furthermore, these were complemented by analyses of the video-recorded lessons.

Science and Technology

Within this subject group there are two theses, one on biology with students of the ages 7-12 years (Vikström, 2005) and one on technology with 7-8 year olds (Björkholm, 2015). Common for these Learning Studies is that their pre-tests are based on video-recordings. Vikström conducted initial, material-based interviews with 18 students. She brought seeds of different kinds, a pot with soil and a plant, to the interview. All these were available for students to use during the interview. An important aspect of preparing the interview situation was the researcher's acquaintance with the local context, of students' previous experiences of the object of learning from lessons preceding the interviews. Thereby it was possible to structure the interviews

around shared experiences and “focus on the same aspects of the object of learning” (p. 180), where the object of learning was defined as the life cycle of angiosperms, concerning matters such as sexual reproduction, photo-synthesis and cellular respiration. The first interview was video-recorded, and these recordings were used for later interviews conducted with students after the teaching sequence. Vikström does not use the words pre- and post-test, instead she has chosen initial and concluding interviews, the purpose of which are to map students’ knowing prior to teaching and to inform teaching. The explicit basis for the second interview is related to students’ experienced learning and the analysis of them was based on theory of variation.

Also Björkholm (2015) used material-based interviews instead of tests for her Learning Studies. As the children were young, she interviewed them in pairs – emphasizing that although the intention was an interview, she rather had prepared for a conversation with the children. The object of learning was defined as evaluating technical solutions in terms of fitness for purpose. For the initial interview, the material she brought was familiar technical solutions for opening and closing, for example a juice bottle, matchbox, zippers and various types of hinges and their opening/closing function – technical solutions the students were familiar with (Björkholm, 2013). For the second Learning Study, she brought to the interviews with children a jumping Jack. Both pre-tests were based on teachers’ previous experiences of possible difficulties, on an analysis of the meaning of the intended knowing as well as on teachers’ judgements of the group of students included in this Learning study, the pre-test was constructed. The interviews were transcribed and analyses to discern qualitative differences in students’ experiences of expediency of the various technical solutions were undertaken. Björkholm defined two purposes for the pre-test: to inform teachers of students’ actual conceptions of the object of learning, and to identify their possibly difficulties related to this. For both her Learning Studies, these differences were then used as a basis for planning the teaching. The post-tests were identical with the pre-test, aiming at identifying how well the students had developed their knowing, with the following lesson revised accordingly.

Music, Theatre, and Dance

Two of the theses involve students from upper secondary school (approximately 18 year olds) and the third children in pre-school and primary school (6-9-year olds).

The object of learning in Wallerstedt's thesis from 2010 is musical temporality, that is, the same piece of music was played for the children with different meters (duple and triple meters). Wallerstedt abandoned the idea of constructing a pre-test; instead she used interviews with the children. In this thesis, there is a clear statement about the contradiction between the idea of pre-/post-test and the theoretical perspective chosen, that is, socio-cultural theory. Instead Wallerstedt emphasizes the need for communication and situatedness of meanings that need to be negotiated in order to arrive at a shared meaning. She therefore chose to interview the children in relation to the song chosen played in two different meters, then took a small drum and played the song in these meters. Finally she asked the child to drum the song. This is another version of the former mentioned material-based (or contextualized) interview, which she argues represents the pre-test. She emphasizes her disapproval of the choice of vocabulary (pre-/post-test), which she identified as belonging to another theoretical tradition. The purposes of her chosen form of pre-test were firstly, to explore and understand students' various ways of discerning musical temporality in terms of meters, and secondly to, describe, based on these analytical descriptions, critical aspects of the ability to discern musical temporality. The subsequent lessons were designed on the basis of the findings in the analysis of the previous lesson. Through the thesis, Wallerstedt reject the idea of counting how many children represented one or the other ways of understanding temporality in terms of meter. The main focus is instead on the varying ways children understand the object of learning in relation to the intended, and on identifying ways for teachers to support (scaffold) children's understanding further. In Wallerstedt's thesis critical reflection on vocabulary, methodological issues related to elicitation of information about children's varying conceptions of the object of learning and how teaching could be designed in order to further children's conceptions are recurrent in the text.

Ahlstrand's (2014) thesis is based on four Learning Studies in upper secondary school (the Arts programme). Students involved are 18 and 19 years old. The subject is Theatre and the objects of learning for each Learning Study are (i) the capability to express presence in a given situation; (ii) the capability to collaborate in a mutual performance (based on written text); (iii) the capability for scenic interaction during a dialogue; and (iv) the capability to affirm each other in a mutual performance (improvisation). She too chose video-recorded pre- and post-tests related to improvisation exercises – a scene from

a play, a dialogue from a play, and an improvisation exercise – each relating to the previously described objects of learning, appearing in the same order. The purposes of the pre-tests were to explore students' previous knowing related to each of the objects of learning. The video-recorded pre-tests were analysed phenomenographically (Marton, 1986), in order to discern critical aspects of the object of learning. These aspects were then used as a basis for designing further teaching. As in Wallerstedt's above-mentioned thesis, no post-tests were used, since the purpose of the study was to discern different ways of experiencing the object of learning.

Also, Nyberg's (2015) thesis involves 18 year old upper secondary school students, with the subject in focus physical education. One of the studies this thesis is based upon is Learning Study, with the object of learning to replicate a sequence of dance movements, one of which was *house-hop* (which is the focus here) as similarly as possible to the teacher's way of moving. The procedure for pre-test was the following: all students observed the teacher while she carried out all movements; no verbal instruction was given. The students were divided into five groups, each group was video-recorded in turns while imitating the teacher almost simultaneously as she repeated the movements. The other groups waited outside. Nyberg also used phenomenography as a method for discerning the varying ways of bodily expressions of conceptions of the object of learning. For the analysis, she represented the variations in sketches, based on the video-recordings. The purposes of the tests were firstly to identify qualitatively different ways of experiencing/grasping a movement to be learnt; and secondly the dimensions in which learners need to experience variation. The latter refers to aspects that teachers needed to acknowledge in their further design of teaching. A post-test is mentioned but there is neither a description of it nor further comments.

Social Studies

One of the theses (Florin-Sädbom, 2015) addresses social studies. This study involves secondary school students (14-16 year olds). Part of the thesis is based on a Learning Study with the object of learning to develop understanding of democracy by studying how civil rights are practiced on a societal level. For this study paper-and-pencil based pre- and post-tests were administered, however the information given about these is vague. They seem to be based on a vocabulary that teachers found students have difficulties distinguishing from each other: words

like *fair, justice/injustice, right, duty* have been used for formulating the tests. The purposes of the tests were to provide information to teachers for their design of research lessons.

Teacher Education and In-service Training

Two of the identified theses were related to certain others besides school students – one involved teacher students (van Bommel, 2012) and the other teachers (Gustavsson, 2008). In van Bommel's thesis, the object of learning chosen is elements of mathematical knowledge for teaching, which relates to mathematics pedagogy, also conceptualised as pedagogical content knowledge (PCK) (Schulman, 1986). In this study, the pre-test was designed as writing a lesson plan for a primary school lesson within a certain mathematical topic (e.g. number sense, rational numbers), using the model for what should be included as presented by Shulman. The post-test followed the form of the pre-test, writing a lesson plan, again based on Shulman's model, but this time for a different content; probability. Alternatives to these pre-/post-tests were considered, however the chosen form of test was found most appropriate since teacher students were asked to show connections between elements of the mathematical knowledge for teaching. For analysing the teacher students' tests, a model of five aspects of mathematical knowledge for teaching was developed. The five aspects were the following: "pupils' preconceptions, models for explanation, related (hands on) materials, suitable exercises, and curricular documents" (van Bommels, 2012, p. 59).

The object of learning for teachers' in-service training in Gustavsson's (2008) thesis is the theory of variation. This thesis differs from the others. The main purpose is related to variations in participating teachers' talk about the objects of learning they work with in the Learning Studies they conduct with their students. For example how these objects of learning were taught and indications of changes in teachers' understanding of variation theory.

Types and Purposes of Pre-and Post-tests

One way of describing similarities and differences in the pre- and post-tests used in the above reviewed theses, is that the tests are of three types: *paper-and-pencil tests*, *interviews*, and *video-recordings*. However, there are also differences between studies that use paper-and pencil tests as well as between studies using interviews. Some of the Learning Studies using paper-and-pencil tests seem to have an un-reflected

approach as no account on test items included is given. In other words: the researchers don't present their considerations for how the object of learning is operationalized into the test items. Since some of the studies use paper-and-pencil tests for the purpose of measuring the differences in students knowing and either the statistical significance of the differences in students' knowing before and after the interventions with a Learning Study (Msonde, 2011), or the statistical effect-size of the Learning Study regarding students' knowing before and after (Kullberg, 2010), it is essential that the researchers also make explicit how the object of learning is constructed for testing. What is the content of the test items that relates to the object of learning?

Other researchers who used paper-and-pencil tests combined them with interviews. Although there were differences between the studies as to whether or how explicit account they made of the tests they used, their argument for combining the tests with interviews with students was that tests could not sufficiently enough elicit students' conceptions of the object of learning (cf. Mårtensson, 2015).

Some of the researchers, who instead have chosen interviews or video-recordings or a combination of these, make their considerations explicit when they argue for how the interview situation was designed in order for the researcher to be able to elicit knowing related to the object of learning and the group of student. Commonly the researchers bring some kind of material to these interview situations in order to create situations where aspects of the object of learning become concrete for an interview-like conversation with students (cf. Björkholm, 2015; Vikström, 2005; Wallerstedt, 2010). The object of learning in Ahlstrand's (2014) and Nyberg's (2015) theses relate to forms of knowing where body/movement/expression/communication are central aspects that call for another approach in order to elicit students' conceptions related to the object of learning. Researchers that chose material-based interviews and/or video-recordings as – or instead of – tests expressed other purposes for the tests than statistical evidence. Here the purposes were focused on, for example, mapping students' conceptions or exploring the variation in conceptions. The purposes of the pre-tests seem related to their functions:

- to measure the point of departure (students' knowledge of the object of learning preceding the Learning Study) and compare this result to a second measurement after the Learning Study (students knowledge of the object of learning after the Learning Study)

- to map students' varying conceptions of the object of learning in order to identify critical aspects necessary to address when designing teaching.

Discussion and Concluding Remarks

Based on the above results of reviewing the Swedish and Tanzanian theses, we found that similar variations in types of pre- and post-tests are represented also in the brief accounts we gave on Learning Studies articles published in the *International Journal of Lesson and Learning Studies*. We therefore pose some challenges and some possibilities for other researchers interested in using Learning Studies as an approach for developing subject-specific teaching in praxis.

Challenges

One of the challenges is that the construct validity of the tests used in relation to the chosen objects of learning and (preliminary) critical aspects can be questioned. This vocabulary is specifically related to measurement studies. If the purpose is to show effects of a Learning Study, these issues must be elaborated on further. Another challenge is related to the statistical basis for the analyses calculated. Also here the researchers considerations need to be made explicit. What kinds of statistical analyses can be done with the kinds of data produced in the tests?

A further challenge is the vocabulary – most of the studies mention the terminology pre- and post-tests although this terminology represent a specific research tradition where an interest in statistical significances and effect-sizes are part of the traditions. Instead of mentioning pre- and post-test only to reject this kind of design (cf. Vikström, 2005; Wallerstedt, 2010), Learning Studies based on other traditions need to develop a vocabulary that matches their purposes.

These different challenges must be seen in the light of researchers within the field. They represent different traditions – or even paradigms – and thus contribute with different kind of knowledge related to their respective uses of Learning Studies.

Possibilities

For those interested in the use of paper-and-pencil tests, with the purpose of measuring differences or success, there is a need to make the relation between the object of learning and the written tests used explicit. Here cooperation with researchers within the assessment field

specialized on operationalization of content specific knowledge into test items could be fruitful.

If the purpose is to become aware of students' various ways of understanding the object of learning and thereby the challenges for teaching, then the issue is how to explore students' knowing. Development of methodological approaches for both the initial mapping and the analysis seems necessary. The variation in subjects represented in the theses reviewed already point in this direction.

The issue of Learning Study as a way for working with formative assessment addressed by Wernberg (2009) in her thesis, and by Nyberg and Holmqvist Olander (2015) in the article mentioned in the beginning of this chapter, point at interesting future collaboration between the two research fields. It also points at the power Learning Study could have as a way of enhancing formative assessment related to developing teachers' teaching in relation to students' learning.

References

- Adulyasas, L. & Rahmann, S.A. (2014). Lesson Study incorporating phase-based instruction using geometer's sketchpad and its effects on Thai students' geometric thinking. *International Journal for Lesson and Learning Studies*, 3(3), 252-271.
- Ahlstrand, P. (2014). *Att kunna lyssna med kroppen – En studie av gestaltande förmåga inom gymnasieskolans estetiska program, inriktning teater*. [To listen with your body. A study examining the capability to act within theatre education at upper secondary school level, in Swedish]. Dissertation. Stockholm University.
- Björkholm, E. (2015). *Konstruktioner som fungerar – en studie av teknikkunskande i de tidiga skolåren* [Constructions in function – a study of technical knowing in primary technology education, in Swedish]. Dissertation. Stockholm University.
- Björkholm, E. (2011). Exploring the capability of evaluating technical solutions: a collaborative study into the primary technology classroom. *International Journal of Technology and Design Education*, 24(1), 1-18.
- van Bommel, J. (2012). *Improving teaching, improving learning, improving as a teacher – Mathematical knowledge for teaching as an object of learning*. Dissertation. Karlstad University.
- Bradshaw, Z- & Hazell, A. (2017). Developing problem-solving skills in mathematics: a lesson study. *International Journal for Lesson and Learning Studies*, 6(1), 32-44.
- Carlgren, I. (2012). The Learning Study as an approach for 'clinical' subject matter didactic research. *International Journal for Lesson and Learning Studies*, 1(2), 3-18.

- Florin Sädboom, R. (2015). *I det didaktiska spänningsfältet mellan styrning och elevers lärande: En studie av lärares tal om och iscensättning av kursplanemål i en mål- och resultatstyrd skola*. [In an era of restructuring of the educational system in Sweden, didactic tension between managing by objectives and student learning: A study of teachers' talk about and staging of curricular objectives in the goal- and results-oriented school, in Swedish]. Dissertation. Högskolan för lärande och kommunikation i Jönköping.
- Gustavsson, L. (2008). *Att bli bättre lärare. Hur undervisningsinnehållets behandling blir till samtalsämne lärare emellan* [Becoming a better teacher. Ways of dealing with the content made a topic of conversation among teachers, in Swedish]. Dissertation. Umeå University.
- Holmqvist Olander, M. & Nyberg, E. (2014). Learning study guided by variation theory: Exemplified by children learning to halve and double whole numbers. *Journal of Research in Childhood Education*, 28(2), 238-260.
- Kullberg, A. (2010). *What is taught and what is learned? Professional insights gained and shared by teachers of mathematics*. Dissertation. University of Gothenburg.
- Lung Tang, C. & Wah Leung, B. (2012). Teaching Cantonese opera in a primary school. *International Journal for Lesson and Learning Studies*, 1(3), 261-275.
- Marton, F. (1986). Phenomenography – A research approach investigating different understandings of reality. *Journal of Thought*, 21(2), 28-49.
- Marton, F. (2015). *Necessary conditions of learning*. New York: Routledge.
- Marton, F. & Pang, M.P. (2006). On Some Necessary Conditions of Learning. *Journal of the Learning Sciences*, 15(2), 193-220.
- Msonde, C.E. (2011). *Enhancing teachers' competencies on learner-centred approaches through learning study in Tanzanian schools*. Dissertation. University of Hong Kong.
- Mårtensson, P. (2015). *Att få syn på avgörande skillnader: Lärares kunskap om lärandeobjektet*. [Learning to see distinctions: Teachers' gaining knowledge of the object of learning, in Swedish]. Dissertation. School of Education and Communication, Jönköping University.
- Nyberg, E. & Holmqvist Olander, M. (2015). A Study of Formative Assessment Strategies in Teachers' School-Based In-Service Training. *International Journal of Learning, Teaching and Educational Research*, 11(1), 53-74.
- Nyberg, G. (2014). *Ways of knowing in ways of moving. A study of the meaning of capability to move*. Dissertation. Stockholm University.
- Olteanu, C. (2007). "Vad skulle x kunna vara?": Andragradsfunktion och andragradsfunktion som objekt för lärande ["What could x be?": Second degree equation and quadratic function as objects of learning, in Swedish]. Dissertation. Umeå University.
- Pang, M.F. & Marton, F. (2017). Chinese lesson study, learning study and keys to learning. *International Journal for Lesson and Learning Studies*, 6(4), 336-347.
- Sadler, R. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18, 119-144.

- Shulman, L.S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, 15(2), 4-14.
- Wallerstedt, C. (2010). *Att peka ut det osynliga i rörelse: En didaktisk studie av taktart i musik*. [Pointing Out the Invisible in Motion: A Didactic Study on Time in Music, in Swedish]. Dissertation. University of Gothenburg.
- Wernberg, A. (2009). *Lärandets objekt: vad elever förväntas lära sig, vad görs möjligt för dem att lära och vad de faktiskt lär sig under lektionerna* [The object of learning. What students are expected to learn, what is made possible for them to learn and what they actually learn, in Swedish]. Dissertation. Umeå University.
- Vikström, A. (2005). *Ett frö för lärande en variationsteoretisk studie av undervisning och lärande i grundskolans biologi* [A seed for learning. A variation theory study of teaching and learning in biology, in Swedish]. Dissertation. Luleå University of Technology.

PART TWO

LESSON AND/OR LEARNING STUDY IN TANZANIA AND SWEDEN

CHAPTER 4

Framing the Cases – a System Level Comparison

Gunilla Höjlund & Noah Mtana

In this chapter some central aspects of the educational system in Tanzania and Sweden are outlined. Even though the two countries' contexts differ in social, economic as well as educational conditions many recurrent challenges to education are shared. These include the tendency to make educational reforms without the input of professionals and instead based on political statements; most especially in the form of a number of costly reform decisions without improving learning, the introduction of new curricula without co-ordination with stakeholder understanding and participation, as well as declining results on national and international assessments and corresponding concern for education quality. The two countries further share the worldwide educational restructuring involving decentralization, liberalization, and marketization that emphasises a consumer orientation and parental choice with a focus on performativity to mention some elements. This chapter describes key features of the respective education system and addresses some of the joint challenges. It contains the following sections: structure of the education system, governance including steering instruments, curriculum issues, and teacher education.

Structure of the Education Systems

The education system of the two countries comprises the same levels – pre-school, primary, secondary and higher education – although the structure/organization of these levels differ. The recent Education Policy in Tanzania (2014) has introduced radical changes in the structure of the education system. Children can start schooling any time between the ages of four and six. The notion of basic education is introduced and includes a compulsory schooling of ten years. These changes so far concern children who started school in 2015 and the reform implementation progresses along with this cohort. This means two structures are to run parallel for some time with the students of this project following the system of the previous policy of 1995 i.e. started school at seven years old to follow a seven-year course of primary schooling (MoE, 1995, MoEVT 2005, 2014). The cases reported in this book were thus framed by the previous system.

The age of starting school in Sweden is seven years with the possibility to start at six years. From the age of six children have the right to enrol at a preschool class and the municipalities have the corresponding obligation to offer and arrange for this class. Thereafter follows nine years of compulsory schooling (Sverige, 2017 [Educational Act 2010: 800]). A majority (more than approximately 90%) of young people further enrol in the non-compulsory upper secondary school, which is more or less a prerequisite to enter the labour market. The movement of prolonging basic schooling by both extending pre-school and secondary education seems to be a general global trend to meet global competitiveness (OECD, 2012). In the table of the respective systems below the two systems are presented (in the Tanzanian case starting with the system the case study students have followed).

Table 1. Composition of the Education System – Main Features

Tanzania 2-7-4-2-3+ parallel 1-6-4-2-3+	Sweden -1-9-3-3+
Pre-school 2 years cycles // 1 year	Pre-school (children from 1, 5 –)
Primary school 7 years// six years	Pre-school class 1 year
Lower secondary school 4 years // forming together with the six years a ten year compulsory basic education	Compulsory school 9 years
Upper secondary school 2 years (A-level)	Upper secondary school 3 years including vocational education and training programs
Higher education from 3 years	Higher education from 3 years
Specific vocational education and training centres	

It could be noted that vocational education and training is part and parcel of the Swedish upper secondary school and encompasses 12 national three year long programs out of a total of 18. Vocational education and training in Tanzania on the other hand constitutes a system of its own, carried out in vocational education and training centres, of normally two years. A difference between the countries that seems important to point out, and which impacts how a study such as this works in the schools, is the position of teacher education in the education system and it will be presented separately later on in a section of its own.

Governance

The public organization of education is fairly similar on a surface level but still embodies key differences. In Tanzania local authorities are elected every five years with the responsibility for overall social services including schools. In Sweden the municipal elections take place every fourth year, and schooling is one of its main responsibilities. The school inspection function is vested in a semi-autonomous body in Sweden while in Tanzania it belongs to the Ministry. Semi-autonomous bodies in both countries develop curricula as shown in table two below. Sweden does not have a special national examination body; assessment and examinations are left to the schools based on national criteria. However, a more centralised system in terms of national tests in some of the subjects has started to develop since 2006.

Table 2. Education Governance Organizations-Primary and Compulsory Education Respectively

Tanzania	Sweden
Ministry of Education and Vocational Training and Ministry of Education, Science and Technology since 2015	Ministry of Education Municipality Education Office Schools
Regional educational authorities	
Local educational authorities at district and wards	
Schools	
Semi-independent bodies are responsible for curriculum development (TIE, or Tanzania Institute of Education and NECTA, or National Examination Council in Tanzania)	National Agency for Education responsible for curriculum development National Agency for Education Inspection

Steering Documents

Main steering documents at national level are shown in table 3 below especially in relation to primary education.

Table 3. Main Steering Documents

Tanzania	Sweden
Education Act (1978 and later amendments)	Education Act (2010)
Education and Training Policy (1995/2014)	Education Ordinance (2011)
Education Sector Development Program (1996)	Municipality school development documents
Basic Education Development Program (2002 and onwards)	Comprehensive school curriculum including subject syllabi (2011) and criteria for assessment (2013)
Subject syllabi (2005/2014-2016)	

The Swedish national steering documents are more streamlined than the Tanzanian ones which include sectorial planning documents developed in the negotiation with development partners. These plans detail government intentions regarding access to education, quality issues, implementation processes and finance requirements and have until 2014 updated the almost 20 years old policy in line with recent national and international developments. In the Swedish context similar plans will be found at local level, the municipalities or schools, while in relation to national reform processes background analysis would be found in the instrument of government inquiries that are documented in the Government Official Documentation Series.

There are further in Tanzania a number of education related documents, which are commonly referred to, all linking education with national socio-economic development. These include the Tanzania Development Vision 2025, which points at universal primary education as a main contributor to the realization of a high quality livelihood for all Tanzanians. The Poverty Alleviation Strategy is another policy framework emphasizing education as a main means to eliminate poverty (Mbelle, 2008).

Mode of Governance

Notions such as decentralization, liberalization and marketization characterize and influence both countries’ governance of the education system. While education in Sweden has a long tradition of decentralization to local level, the municipality and schools, Tanzania’s

case is one where in recent times there has been talk of de-concentration i.e. administrative delegation of governmental functions (Lauglo, 1995). Capacity to plan and manage education at local levels in Tanzania's districts and wards is in its infancy. A joint experience is so-called school-based management seeking to make schools accountable for their decisions and activities. In Tanzania, the school committee is the governing board of the school making decisions on how to spend funds such as on the purchase of material. The head teacher is the secretary of the committee. The Swedish curriculum for the compulsory school spells out the pedagogical and economic responsibilities of the head teachers (Skolverket, 2011).

Along with decentralization, liberalization of regulations opens up private initiatives such as for-profit schools in Tanzania based on school fees while in Sweden independent-for-profit schools are based on a public financed student voucher system. This has led to schooling as a market for parental choice, especially in the Swedish context, and a breaking down of the ideology of education as a public good, opening up the public sector monopoly for strategic investment by profit firms (Robertson, 2007).

The move to result governance during the last decade implies that the expected results govern the education i.e. backward education governance. Teaching is planned as a gradual movement towards the expected results. In the past the control of the education system was mainly pro-active i.e. detailed rules and regulations, while today it tends more toward the retroactive kind i.e. inspections systems (Carlgren, 2015). This is particularly the case of Swedish reform work during the last decades while detailed regulations still characterize Tanzanian governance to a great extent.

An attempt to summarize various aspects of governance is shown in table four below. It uses the parameters of centralization and decentralization. An attempt to summarize various aspects of governance is shown in table four below. It uses the parameters of centralization and decentralization.

Table 4. Comparative Summaries of Some Aspects of Governance

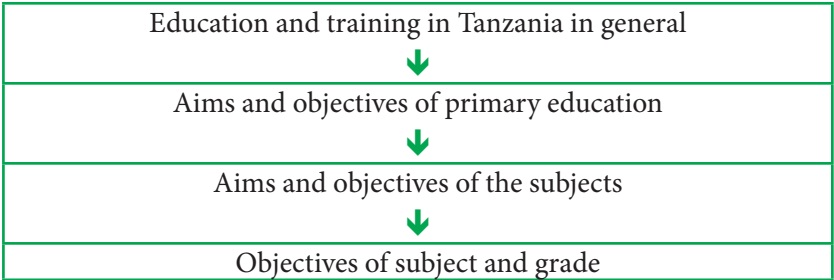
	Tanzania	Sweden
Goals	Centralized	Centralized
Curriculum	Centralized some limited possibilities for local initiatives and local interpretation	Centralized some possibilities for local initiatives and local interpretation

	Tanzania	Sweden
Goals	Centralized	Centralized
Operations	Decentralized to schools, public and private	Decentralized to schools, public and independent
Admission of students	District, single school	Municipality, single school
Teacher education and training	Centralized but allowing private institution	Delegated to universities

Curriculum Issues

In both countries a rule/regulation and content steered curriculum have been replaced by a goal and result steered curriculum and syllabi. The goals are formulated in terms of competences and capabilities that students should develop aligning with the governance policy mentioned above. The Tanzanian curriculum, which the students who participated in the study have followed, lays out aims and objectives at different levels as follows (MoEVT, 2005).

Figure 1. The Tanzanian Curriculum System Valid During the Case Studies



Aims of primary education in Tanzania include to acquire value and respect for the common cultural background and social customs and traditions, to acquire Kiswahili (language) and respect the language as a symbol of national unity, to enable children to understand the fundamentals of the national constitution, basic learning literacy, communication and numeracy. The subject syllabi are uniformly organized in the components: competence --topic and sub-topic – specific objectives – teaching and learning strategies – teaching and learning materials – assessment periods (ibid.).

The overall Swedish curriculum in its turn contains three parts:

- 1. Fundamental values and tasks of the school
- 2. Overall goals and guidelines for education
- 3. Syllabi, which are supplemented by knowledge requirements

In the first two parts of the Swedish curriculum it is stated that four perspectives should characterise all teaching namely historical, environmental, international and ethical perspectives. Knowledge is conceived of as facts, understanding, skills, and familiarity and accumulated experiences. Overall goals and guidelines specify what students should have acquired by the time they leave the compulsory school. They also discuss responsibility and influence by students, teachers, and head teachers, the relationship between school and home, school and surrounding society etc.

The subject syllabi respectively contain: a) aim of the subject b) a summary of the long-term capabilities that the students should be able to develop c) core content pointed at for school year 1-3, 4-6 and 7-9. The aim, long-term capabilities and core content are supplemented by d) assessment criteria with a grading scale A-F. The content areas should be taught in such a way that students develop the stated subject-specific capabilities (Skolverket, 2011).

Primary School Respective Compulsory School Subjects

Subject composition of the Tanzania primary school and of the Swedish compulsory school is shown in the table below. It is rather similar and complies with worldwide common subject composition.

**Table 5. Primary Respective Compulsory School Subjects
(Main Feature)**

Tanzania Standard I-VII	Sweden Grade I-IX
Kiswahili	Swedish
English	English
Mathematics	Modern languages (from year 4)
Science (natural)	Mathematics
Social Studies	Science Studies
Vocational Skills	Social Studies
Religious instruction	Physical Education and Sports
Physical education and sports	Arts
<i>The new curriculum</i>	Music
From Standard 3 on the above subjects are gradually introduced and Technology is part and parcel of Science. In addition an optional language, French or Arabic, is offered in Standard V and VI.	Home and Consumer Studies Crafts i.e. needle, metal and wood work Technology

Natural Science subjects encompass Biology, Physics and Chemistry in both countries and Social Science subjects refer to History, Geography and Civics and also Religion in the Swedish curriculum. In Sweden the different subject areas for both Natural and Social Science have different syllabi for each subject while they are integrated and thematically organised in the Tanzanian curriculum. Tanzania is further rather unique by including vocational education at primary school level. The subject, Vocational Skills of the 2005 policy, comprised of 11 skills areas and including the Swedish subjects Arts, Music, Home and Consumer Study and Crafts (MoEVT, 2005; Skolverket, 2011). In the new curriculum the Vocational Skills are reduced to four areas namely good grooming, mastering of receipts, creating work of arts and knowing entrepreneurial skills (MEST, 2016)

Teacher Education (Pre-service)

Traditionally primary school teacher education has had a focus on practical training (instructional methods), on supervised teaching practice (often in model or demonstration schools), and on ethos and a concern for the personality. In the Swedish context this is referred to as the “seminarietraditionen” and internationally to the “normal school tradition” (Carlgren & Marton, 2000). It also has traditionally had a national assignment to fulfil. Today teachers are required to prepare students for living in a globalized world and to lay the basis for a lifelong learning process. This has resulted in more and more convergent approaches. Teacher education in both countries have recently been reformed, Tanzania in 2015 and Sweden in 2011. Some features of the current teacher education for the Tanzanian primary school (pre-service) and the Swedish compulsory school are described below country wise.

Table 6. Teacher Education in Tanzania

Where	Teachers college
Eligibility	Lower secondary school
Duration	Two-three years
Program	Early childhood education, which prepares teachers for pre-schooling and the teaching of 3Rs (reading, writing and arithmetic) to children of Grades I and II
	Primary school teacher education preparing teachers for primary schools (from Grade III to VI)

Content	i) Education courses (i.e. educational philosophy, sociology and psychology), Communication Skills, Development Studies and ICT for all
	ii) Content and methodology for teaching: either 3Rs (for early grades teachers) or primary school subjects (for primary school teachers).

Table 7. Teacher Education in Sweden

Where	University and University College
Eligibility	Upper secondary school
Program	Degree in primary school education with three specializations
	(i) Work in pre-school class and year 1-3
	(ii) Work in year 4-6
	(iii) Work at out-of-school care
	Degree in subject education for work in year 7-9 and upper secondary school
Duration	Three to five years
Content	Subject studies, education science (core), teaching practice

Teacher education for all school levels in the Swedish system has been part and parcel of the university education since 1977 while in Tanzania this is only the case for advanced levels of secondary school. The bulk of teacher education programs in Tanzania are conducted at Teachers Training Colleges. Recent reform aims at making the colleges more professional and autonomous by allowing them to develop their own curricula and examinations under the supervision of the National Council for Technical Education (NACTE) instead of functioning as a school category examined by NECTA with curricula prepared by TIE.

It should be noted that teachers in the research project have attended former programs. In the Tanzanian case for example a two-year general program after lower secondary education for preparing primary school teachers. Such teachers advance themselves (while working) to degree programmes in universities. In the Swedish case for example teacher education leads to an academic degree on Bachelor's or Master's level.

A recent Swedish reform could be of interest to mention, the certification of teachers and preschool teachers, which was initiated in 2011 but in full operation 2015. The purpose of the reform is to raise the level of skills among teachers and preschool teachers so as to improve the quality of educational services. The Swedish National Agency for Education takes decisions on certification, which requires a degree in

education or in preschool education. Only certified teachers will be eligible for permanent employment as well as for marking.

In-service Teacher Education and Training

The scope of in-service education and training is usually multiple including certification courses for unqualified teachers, upgrading/ updating through courses that are often curriculum related, as well as preparation for new roles. While the initial, pre-service teacher education phase traditionally has been a phase of full-time studies at specialized institutions or semi-distance based, the institutional framework for in-service education and training has been very open to include private, non governmental organization, teachers resource centre, university and community provisions (for example Villegas-Reimers, 2003).

The notion of continuous professional development has entered discussion on in-service in both countries. Continuous professional development needs to address the issue of accreditation of previous education as well as actual competence and consequently qualification frameworks are established in both countries. In Tanzania a recent framework managed by NACTE is established for middle institutions between schools and university and allows for growth in steps. It includes nine levels and teacher education has just entered the framework (TUC, 2010). A unifying framework for qualifications is being established in Europe, the EQF (European Qualifications Framework). The purpose of the framework is to make it easier for EU citizens to compare qualifications – from studies as well as from professional life. The framework will serve as a collective system for qualifications, awards, certificates and diplomas. All participating member states are developing national frameworks to be connected to the main European framework. The progress reached by the different countries varies. Sweden has two existing frameworks: the framework for qualifications for lifelong learning and the framework for higher education. In addition a national framework has been inaugurated comprising knowledge, skills and competences in eight levels starting with the public education system (Swedish National Agency for Higher Education, 2012).

Tanzanian traits and developments

Given the education level of the primary school teachers in Tanzania, in-service education has been imperative, especially because of frequent

changes in school curricula. In relation to costs, effectiveness and sustainability, there have been competing views about whether in-service programs for teachers should be residential or school-based. Traditionally, such programs have been residential in which teachers went to college for re-training for several months. These residential programs are criticized for being too costly in terms of time and money. To keep teachers in the college for three months, for example, costs a lot of money and time. In addition, residential programs separate training from practice by taking the teachers away from their work places. Such programs have heavily relied on foreign aid and thus, are difficult to sustain. Currently, there are efforts to prepare school-based programs in which teachers study while working (Mhando, 2006).

Swedish traits and developments

Swedish teachers are guaranteed about 100 hours of in-service education per year. The scope of in-service education and training is wide and ranges from one-day guest lectures for all teachers at a school to individual postgraduate research studies within the frame of so-called research schools. University courses in pertinent areas such as assessment and grading and Math's teaching (didactics) are another common form of in-service education. There are also examples of large-scale programs for example "reading lift" focusing on reading and writing through collegial learning with support of a mentor/supervisor. The latter are an example of government interventions (Nyvaller, 2015).

In Sweden Lesson and Learning Studies have become often-used models for teacher led school development. These models are also used as models for in-service training in the form of collegial learning.

References

- Carlgren, I. & Marton, F. (2000). *Lärare av i morgon* [Teacher of tomorrow, in Swedish]. Stockholm: Lärarförbundets förl.
- Carlgren, I. (2015). *Kunskapskulturer och undervisningspraktiker* [Culture of knowledge and instruction practice, in Swedish]. Göteborg: Daidalos.
- Lauglo, J. (1995). Forms of Decentralisation and Their Implications for Education. *Comparative Education*, 31(1), 5-28.
- Mbelle, A. (2008). *The Impact of Reforms on the quality of Primary Education in Tanzania*. Research Report 08.1. Dar es Salaam: Research on Poverty Alleviation (REPOA).
- Mhando, E. (2006). Paper on Teacher status in Tanzania to the first meeting for national coordinators for the UNESCO Teacher Training Initiative for Sub-Saharan Africa, Dakar, Senegal.

- MoE (1995). *The Education and training policy*. Dar es Salaam: Adult Education Press.
- MoEVT (2005). *Subject syllabi for primary schools*. Tanzania Institute of Education.
- MEST (2016). *Subject syllabi for basic education*. Tanzania Institute of Education.
- Nyvaller, M. (2015). *Pedagogisk utveckling genom kollegial granskning: fallet Lärande Besök utifrån aktör-nätverksteori* [Pedagogical development through collegial review, in Swedish]. Göteborg: Acta universitatis Gothoburgensis.
- OECD (2012). *Better skills, better jobs, better lives: A strategic approach to skill policies*. OECD Publishing.
- Robertson, S. L. (2007). *Globalization, education governance and citizenship regimes: New democratic deficits and social injustices*. Bristol: Centre for Globalisation, Education & Societies.
- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011: Lgr11*. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Sverige (2017). *Skollagen (2010:800): med lagen om införande av skollagen (2010:801)* [Education Act, in Swedish]. (Åttonde upplagan). Stockholm: Wolters Kluwer.
- Swedish National Agency for Higher Education (2012). *Certification of Sweden's national qualification framework*. Högskoleverkets rapportserie 2012:12 R..
- TUC (2010). National qualification framework. Dar es Salaam TUC (Tanzanian University Commission)
- Villegas-Reimers, E. (2003). *Teacher professional development: An international review of the literature*. UNESCO: International Institute for Educational Planning.

CHAPTER 5

Framing the Cases of Science in Tanzania and Sweden

Gunilla Höjlund, Inger Eriksson & Kalafunja Osaki

Natural Science subjects encompass Biology, Physics and Chemistry in both countries, Tanzania and Sweden. The subject areas are addressed integrated and thematic in the early Grades (1-3) in Sweden and throughout primary school in Tanzania. The three subjects can though be distinguished in the broad content areas of the Tanzanian syllabus: health, environment, living (Biology), non-living (Chemistry and Physics). In addition to the science content the Tanzanian syllabus also includes cross cutting issues such as HIV/AIDS, road safety education, drug abuse, family-life, education and gender. These are either integrated as topics or as sub topics or as the teaching and learning strategies (MoEVT, 2005; Skolverket, 2011). In Sweden each subject have its own syllabus, however the long-term stated capabilities are formulated in almost identical ways. The core content distinguishes one subject from the other. In Chemistry, Matter is a content area in Grade 6 in both countries.⁹

⁹ Matter is still a content in the subject Science and Technology in the new Tanzanian Education Policy from 2014 but now mainly in Grade 5 (MEST, 2016).

General objectives of Tanzanian primary school science are for students to:

- acquire and apply scientific processes
- acquire and use technology for sustainable manner in every day life
- use principles of science and technology as well as develop a positive attitude towards these. (MoEVT, 2005)

In the Swedish curriculum teaching should develop students' capabilities to develop their ability to:

- use knowledge of chemistry to examine information, communicate and take a view on questions concerning energy, the environment, health and society,
- carry out systematic studies in chemistry, and
- use concepts of chemistry, its models and theories to describe and explain chemical relationships in society, nature and in people. (Skolverket 2011: 135)

Each of these capabilities is to be realized in relation to different content.

The syllabi intentions are rather similar in the countries, but preconditions for teaching differ. The Tanzanian schools are challenged not only by large classes and high student-teacher ration but lack of equipment, laboratory materials and apparatus. Further it is rare that the students have a textbook. This means little or no practical work and has caused the content of Science to be presented as a rigid body of facts, theories and rules to be memorized, which has reduced students' interest and motivation to learn science (Osaki, 2004, 2007; William, 2012). In Sweden each school has a well-equipped science classroom and substances to be used. Further, each student is provided with a science textbook. Compared with the Tanzanian students the Swedish students have a favourable situation for science learning with well-trained teachers and equipped schools, as well as smaller and more manageable classes.

Matter is the topic for the two Lesson and Learning Studies cases presented and discussed in this chapter; "classification of matter into three states" (Kaloleni Primary School) and "the ability to explain why matter is conserved even when it changes from one phase to another" (Hallsta Compulsory School).

Matter is regarded as a difficult topic belonging to Chemistry which in its turn is regarded as a difficult subject especially for the primary school teachers to teach. Some researchers argue that one reason behind this is that the topic as well as the subject as such deals with things

that are not readily visible. Instead students need to learn and handle different types of representations (Gilbert & Treagust, 2009). In order to enable students to discern the variation in states of matter and to understand different forms of representation, researchers and teachers have to create a situation where a proper variation is made available for the students.

In the two Science cases the situation unfolded differently in Tanzania and Sweden based on the teachers and researchers' interpretation of the curriculum and students' experience. The case descriptions below describe the teaching in the two cases.

References

- Ministry of Education and Vocational Training (2005). *Science syllabus for primary schools Standard I – VII*. United Republic of Tanzania
- Ministry of Education, Science and Technology (2016). *Science and Technology syllabus for Standard III-VI*. United Republic of Tanzania
- Osaki, K. M., Hosea, K. & Ottevanger, W. (2004). *Reforming science and mathematics education in Tanzania. Obstacles and opportunities*. Dar es Salaam. TEAMS project
- Osaki, K. M (2007). Science and mathematics teacher preparation in Tanzania: 1966-2006: Lessons from teacher improvement projects in Tanzania, 1965-2006. *International Journal of Education*, 2, 51-64.
- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011*: Lgr11. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Gilbert, J. K., & Treagust, D. F. (2009). Introduction: Macro, submicro and symbolic representations and the relationship between them: Key models in chemical education. *Multiple representations in chemical education*. Springer.
- William, F. (2012). *Enabling science teaching and learning in rural High schools in Tanzania: design and development of integrated Chemistry modules for A level secondary education*. University of Dodoma.

Chapter 5.1

The Tanzanian Science Case: States of Matter

Francis William & Festo Beda Nguru

Introduction

The Learning Study for the Science case was conducted at Kaloleni Primary School (KPS). The school is located in Dodoma Municipality at Uhuru Ward. In short, the main economic activities of the community members around the school include running restaurants and bars, welding, selling timber and household shops. The school was established in 1958. Since the establishment of KPS, heads of schools have been changed on average every three years. The school has been headed by 18 heads of school since its establishment. During the implementation of the Learning Study project, Mr Zephania Issack was head of school and a science teacher at the school. He was recruited as head of KPS in 2012. Zephania graduated Bachelor degree of education in Arts (BED-Arts) in 2011. However, he was promoted to Primary School Inspector in 2015 before the completion of the project.

During the implementation of the project the school had 32 teachers, i.e. 4 male and 28 female teachers. Out of this number, only 5 (i.e. 4 female and 1 male) teachers were science teachers. The school had 465 enrolled students (i.e. 220 boys and 245 girls) who were accommodated in 12 classrooms with 11 streams from pre-school students to primary

Grade 7. All classes from pre-school to primary Grade 4 had one stream, but there were two streams per grade from Grade 5 to Grade 6.

There was not a specific identified textbook to be used by both teachers and students during science teaching; instead, three different books written by different authors were found to be used during the study. The books included:

Mture Educational Publishers (2010). *Sayansi kwa vitendo; Kitabu cha mwanafunzi 6*. Dar es Salaam: Mture Educational Publishers.

Kilama, H. & Kalugula, C. (2010). *Sayansi shule za msingi*. Dar es Salaam: Oxford University Press.

Sibuga, K.K. & Minisi, S.A. (2010). *Tujifunze sayansi: Darasa la 6*. Educational Books Publishers.

Generally, there was a shortage of facilities for teaching science subjects, including science kits and books. For instance, the students:book ratio was 20:1 and that seemed to be a challenge.

The school performance trend in Primary School Leaving Examination (PSLE) from the year 2006 to 2013 was average with the mean pass rate of 65 percent. For instance, in 2013, the school held 2253rd position in the national examination among the 15656 primary schools that did the examinations. However, the performance has fluctuated, though with different number of students. For example, in 2006 the pass rate within the school was appealing as 90% (n= 152) of students passed PSLE. The trend declined in 2010 where the pass rate was 44% (n=168) and rose to 54% (n=106) in 2012; 86% (n = 90) in 2013. In 2014, the performance rate was 80% (n = 64). Statistical analysis of these variations in performance reveals that as enrolment rate increased, performance decreased; thus, the Lesson and Learning Study project was introduced to seek to work with the teachers in an attempt to improve teaching and learning.

Participants in the Science Case

The Learning Study Science case involved Grade 6 (11-12 year olds). There were two streams in Grade 6, Grade 6A with 39 students and Grade 6B with 35 students making a total of 74 students. There were four science periods of 40 minutes per week and different teachers taught each stream. The teachers who were involved in Science case were Ms Irene Makule, Ms Mary Chigarula, Ms Joyce Ikanga, Mr Zephania Issack and Ms Dominatha Benjamin. These were the teachers who taught Science from Grade 1 to Grade 7 at KPS. They all worked as co-researchers in the project.

Choice of Topic and Object of Learning

The object of learning in the Science case involved states of matter. This is a Grade 6 topic from the Science syllabus for primary school (WEMU, 2005). Informal interviews and discussion among teachers revealed difficulties in teaching and learning of some topics, including the structure of matter, energy, machines and work. It was, therefore, agreed during the discussion between teachers and the researchers that discernment of object of learning could be done through pre-test and students' interviews. These focussed on students' ability to classify things according to the three states of matter: solid, liquid and gas. The teachers identified this to be a difficult task for students. Findings reveal that teachers hardly managed to guide students in how to classify things like perfume in a bottle, lubricants and oil, and flowers into specific states. They only used explanations and examples to describe the three states of matter.

Pre-testing

The pre-test items were constructed to confirm the preliminary object of learning (LO) and to discern critical aspect (CAs). Three specific areas/items were included in the pre-test:

- Sorting out and grouping objects according to the states of matter. The list of the objects included milk, tea, stone, salt, oxygen, perfume, soft porridge, rubber, ice, coin, candle, petrol, oil, air, steam, hydrogen, oxygen;
- Naming the forms of the three states of water (i.e. ice, water and steam); and
- Describing any distinguishing features of the three states of matter.

The Object of Learning and Critical Aspects

The findings from the pre-test items showed that the students had difficulties in grouping lists of things into solid, liquid and gas states. Only fifteen students could classify solids, liquids and gases correctly. Other students mixed stone, perfume, and salt in the solid state, they mixed perfume, cooking oil, water, air, soft porridge, tea and juice in the liquid state and they mixed salt, pencil, petrol, kerosene, electrical stove, biogas, cooking gas, oil, and gas containers in the gaseous state. Based on the second item, only six students could mention the three forms of water: ice, water itself, and steam, although the syllabus showed that they would have learned that when they were in Grade 3. Some students classified the states of water as normal water, soft water and hard water; some classified the forms of water as fresh water and

salty water. On describing the distinguishing feature of the states of matter, only four students named the closeness of its particles as the unique feature. Other responses could not represent relevant ideas. It is important to recognize that children construct ideas, which make sense to them personally, on the basis of their experiences (Sharp, et al. 2009) including classroom experiences.

Discussion of the findings and observations from the pre-test led to the identified object of learning: The students should be able to classify matter into three states. Two critical aspects were identified: the students needed to distinguish one state of matter from another on the basis of compactness (density) of the particles; and they also needed to distinguish water, ice and steam as three states of matter characterised by the change of the compactness of the particles facilitated by a rise or decrease in temperature and recognize a perfume in a container as a gas but not liquid on the basis of pressure change.

Variation Theory and its Application in the Research Lesson

The idea that every concept, situation or phenomenon has particular features and that, if a feature is changed or varied and another remains unchanged, the altered feature is likely to be noticed. This is identified as a fundamental point of departure in variation theory (Kullberg, 2010). Variation theory was applied in the study by cooperatively exploring the critical aspects and selecting the best techniques to help students discern the object of learning. Teachers and students' various experiences were involved in the planning and implementation of the research lessons. Variation theory as a pedagogical design tool was applied through considering the variation patterns of contrast, separation, fusion and generalisation in designing and implementing the lessons. The aspects which were dealt with in the research lesson are the properties of matter, like mass, states of matter, shape, volume, hardness (density) and temperature, which distinguish the three states of matter. In the lesson, using various things, we showed how the state could remain the same with different shapes, and volumes. Also, we showed how an object remains the same thing but existing in different states according to the temperature state, with an example being the existence of water as ice cream, water and steam. We also showed how things can exist in the same state but different shapes; as solids having definite shape and volume, liquids having definite volume but taking the shape of its container, gases having neither definite shape nor definite volume.

Moreover, we also showed how objects of the same state exist with different degrees of hardness (softness). For instance, wood, iron, sand and bread are all solids with different degrees of hardness (softness).

The Iteration of the Research Lesson

Pong and Chik (2005) describes the Learning Study cycle as an iterative approach that enables a research team to properly deal with the object of learning. The Learning Study case involved one lesson that was studied through implementation in two cycles. This is the iterative approach that resulted into two research lessons of varying quality because of the improvements done from the observations and findings from the preceding lesson. This is to say, the second research lesson was an improvement on the first research lesson.

The First Cycle

This cycle involved the implementation of the first research lesson. The lesson was about the three states of matter (maada na hali zake). Lesson one was implemented to Grade 6B by Ms Joyce Ikanga while Ms Irene Makule and Ms Mary Chigarula, Prof Osaki, Dr Francis and Mr Festo were observing and recording.

The competence targeted for the lesson was to enable students to classify things around them into the three states of matter. The main objective of the lesson was to describe matter and its states. Specific objectives of the lesson were to enable students to identify the states of matter of the objects around them. It was observed that most students hardly recognized perfume in a bottle as a gaseous state because of the hardness of the container and so they classified perfume in the container as solid. It was also observed that the lesson did not consider forms of water as the most critical aspect in assisting students to discern the three states of matter. Similarly, the lesson did not consider temperature as an important aspect in explaining the conditions for the change in the states of matter, i.e. the lesson did not include an activity that demonstrated change of ice into water and steam when illustrating the three states of matter.

It was also observed that some activities, including brainstorming in think-pair-share, sorting out things into states of matter, and presentation and discussion of students' findings took longer than planned. Nevertheless, students' performance in the given activities was good.

The research team, therefore, made the following suggestions for improvement of the second research lesson. First, was to observe time management in the introductory part, presentation and discussion.

This was planned to be fulfilled by allowing two groups to present and, therefore, quickly discussion missing information from other groups. Second, tackle two examples of substances that exist in gaseous state as the past lesson had only one example, which was perfume. Third, put more emphasis on the properties of matter than insisting only on the compactness of particles, when distinguishing the three states of matter. These properties include hardness, volume and shape, ability to flow and spread. Finally, add more and proper use of the teaching and learning materials, including ice, water, perfume, pieces of chalk, kerosene, cooking oil, notebooks, balloons, sugar, stones, maize, salt and pencils.

Second Cycle

This involved the implementation of the second research lesson. The lesson was taught in Grade 6B and it was facilitated by Ms Mary Chigarula. The teacher used ice cream in demonstrating change of solid matter to liquid. The teacher also demonstrated gaseous state of perfume in a bottle by spraying it at one corner of the classroom and allowed students to feel the smell in the entire classroom. The emphasis of the lesson was more on the arrangement of the substances according to the three states of matter than considering differences and/or similarities of the substances. Thus, the presenter spent more time on students' hands-on activities. The groups were reduced to at most six students to allow more participation. After presentation of the lesson, panel discussion and reflection revealed that demonstration of changes of states of matter by using ice, spraying of perfume, increase of materials and reducing the size of the groups had more impact on students understanding in Lesson 2 than in Lesson 1.

Reflection over the Iteration of Research Lesson

There was improvement from this iteration of the research lessons. The second research lesson seemed to improve students learning more than the first research lesson. This is accounted for by the fact that the research team worked together from the initial stages of identification of the object of learning to critical aspects such as the iteration of the research lessons. For instance, Ms Mary Chigarula who implemented the second research lesson participated actively in all stages involved; i.e. in designing, implementation and reflection of first research lesson. This teacher was one of the classroom observers of the first lesson. We believe that the critiques of the first lesson by the research team significantly impacted the teaching of the second research lesson.

The second research lesson managed to differentiate gaseous states of perfume by enabling students to distinguish the container carrying the perfume, which seemed to be in liquid state and the perfume itself outside the container. The lesson also rephrased the activity that required students to sort substances according to their differences, to sorting according to the three states of matter – which seemed to be more comprehensive to students. Similarly, the lesson had more activities arranged from the concept development to the discernment of the three states of matter that enabled the presenter to deal well with the critical aspects in the object of learning. This seemed to give a clear picture of the prior understanding of students about the object of learning and critical aspects. This enabled the lesson to focus on the fulfilment of critical aspects by giving students more chance of doing hands-on activities.

One of the observed critical issues that enabled students to discern critical aspects was the use of different amount of maize grains in a role play that demonstrated the concept of compactness of the particles in matter. This was used to distinguish the three states of matter based on the movement of particles in matter following change in temperature.

However, it was observed that the teacher spent much time writing on the chalkboard and administering more opportunities for students to interact with the teaching and learning materials. As a result, the second lesson took 112 minutes – 12 minutes more than the first lesson. This suggests that less writing on the chalkboard and better presentation of factual issues is required in lesson presentation during the Learning Study to help teachers focus more on students' activities. Nevertheless, the lesson was important to contain a lot of activities that make use of real things in order for students to understand the concepts more clearly. For instance, students initially understood liquid as anything that contains water. What they did not know was the concept of liquid in relation to the compactness (density) of the particles in matter and its ability to move (flow) from one position to another. Through demonstration, using real matter, they were finally able to learn that liquid can be anything, given that it can freely move from one position to another.

Post-test

The implementation of the post-test was done after the accomplishment of research lesson one and two. It is important to recall that the two research lessons were implemented with different groups of students in the same class. The items in the post-test were similar to the items in the pre-test. The test consisted of five items. The first item required

students to identify which were matter among stone, water, pencil, air, or if they thought all were matters. The objective of this item was to test the students' understanding of the meaning of matter. The second item required the students to classify milk, tea, stone, salt, oxygen, perfume, and soft porridge into three states of matter. The third item required the students to state the names of the three states of water in the three states of matter (i.e. ice as solid, water as liquid and steam as gas). The fourth item required the students to mention important features, which they perceived as critical in distinguishing the three states of matter. Lastly, the fifth item required the students to mention the smallest particle of matter. This item was given in order to test the idea that matter is not continuous, it is made up of particles; the smallest particle being the atom. The post-test was similar to the pre-test to enable the research group to study any cognitive gain before and after the implementation of the research lessons.

General observations from the post-test results showed that students were able to understand that all things are matter. Most students managed to sort out things into solid, liquid and gas correctly. However, eight students (10 percent) of the students – in both pre-test and post-test considered air as non-matter because it is not visible. They put gas containers in the same group of the balloons for gas, instead of solid. That is, instead of talking about the gas inside the container, they only mentioned the container as a gas. In addition, sixty-six students (94 percent) were able to identify and name the three states of water as ice, as liquid and vapour.

Thirty-seven (37) students could identify the compactness of the particles as the significant feature that distinguishes the three states of matter. The other students mentioned the macroscopic properties such as easiness of flow, the degree of hardness/softness, shape and volume as the distinguishing features. The results from pre-test and post-test for research lesson 1 and 2 are summarized in Table 1.

Table 1: Descriptive Statistics of Pre-test and Post-test Results

Group	N	Pre-test		Post-test	
		Mean	Std	Mean	Std
6B	35	45.3	13.3	62	2.6
6A	39	41.3	22.7	74	2.5

Although the pre-test results for group one (6 B) proved to have higher potential, $m = 45.3$ ($N = 35$, $Std = 13.3$) than in group two, $m = 41.3$ ($N = 39$, $Std = 22.7$) the situation was different in the post-test. The post-test

mean score for group two was 74 ($N=39$, $Std = 2.5$) and that of group one was = 62 ($N = 35$, $Std = 2.6$). This suggests that students in the second group (STD 6A) performed better in the post-test than students in group one (6 B). This could be because the second research lesson was improved compared to the first research lesson.

Concluding Remarks

The Learning Study in this research project was conducted through collaboration of researchers from the University of Dodoma and practitioners who are subject teachers in identifying students' learning challenges and design and develop the solution to address the challenges. This has proved to be of paramount importance in building confidence in teachers for engaging into school based professional development and research. This can be achieved through working together in identifying teaching and students' challenges that affect expected outcomes. It was evidenced that before implementation of the Learning Study approach in the Science case, some teachers perceived the topic of matter as challenging to students learning. However, after the implementation of the two research lessons through collaboration the participating teachers realized that students learned and understood the concept of matter and its three states more easily than they did before.

This chapter, therefore, concludes that the Learning Study approach serves as a means of engaging teachers in a form of in-house professional development programme and research. The model can enable the teacher to address students' learning difficulties in Science through an iterative approach. However, novice teachers may need regular mentorship in the process of identifying learning difficulties, planning, implementation and revision of the research lesson.

References

- Kullberg, A. (2010). *What is taught and what is learned: Professional insights gained and shared by teachers of mathematics*. Gothenburg: University of Gothenburg.
- Lo, M., Pong, W. & Chik, P. (2005). *For each and everyone. Catering for individual differences through learning studies*. Hong Kong: Hong Kong University Press.
- Wizara ya Elimu na Mafunzo ya Ufundi (2005). *Muhtasari wa Sayansi kwa Shule za Msingi Darasa la I – VII*. Dar es Salaam: Wizara ya Elimu na Mafunzo ya Ufundi.

Chapter 5.2

The Swedish Case: When Matter is a Matter in a Learning Study

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Background

Hallsta School is a primary and lower secondary school with approximately 300 students, situated in a small conurbation 100 kilometres north of Stockholm, the capital of Sweden. Approximately 40% of the students have Swedish as their second language. Some students are born in another country and others have parents born abroad, which often means that they speak language other than Swedish at home.

The size of the classes varies between 20-28 students. Each student has her/his own desk in the classroom equipped for Science studies. The classroom is spacious and can easily be rearranged, for example, for group-work. Both the technical standard and the scientific equipment standard are high. Each student can use a textbook for the school year. Further, each student has a personal computer as a loan during all the school years provided by the municipality.

During the school year 2014-2015 a Learning Study was performed and approximately 80 students participated in the study. The students were 12-13 years old, in Grade 6 and 7. The study comprised three

iterative cycles and initially all of the students participated in a pre-test. Each cycle was conducted with a new class of students, and consisted of a lesson and a post-test. Different teachers from the research group held each lesson. Four qualified and experienced Science teachers together with two tutors, also qualified and experienced Science teachers, carried out the study. The teachers and tutors will be mentioned as the research group further in this chapter.

Figure 1: The Science Classroom and Some of the Participating Students



Identified Problem

In the national test for Grade 6 of Science (Chemistry) of 2014 there was a task aiming to investigate the students' knowledge concerning the conservation of matter (states of matters). The task in the national test considered two pictures (which we are not allowed to publish). One picture showed a goblet with a tight lid, containing ice cubes and the students received the information about the weight. Another picture showed the same goblet when the ice had melted into water. The students were supposed to answer if the weight of the goblet in the second picture would be: heavier, lighter or equal compared to the initial weight. The result showed that several of the students perceived that matter changes weight when it changes phase.

Talanquer (2009) shows that students' alternative conceptions and models about the structure of matter and its changes have been an

object of a large number of research studies over several years. Earlier research also shows that the concept of matter is crucial for students' understanding of a whole range of Science phenomena and processes (Vikström, et al. 2013).

Matter can be transformed, but not created or destroyed, through physical and chemical processes. [...] Mass and weight are conserved in physical and chemical changes because atoms are neither created nor destroyed. [...] In physical changes, molecules change arrangement and/or motion but remain intact, so the chemical substance remains the same. (Smith, Wiser, Anderson & Krajcik, 2006, p. 13)

All this background together was the reason why the research group would like to explore this content further. Prior to the analysis of the national test we took for granted that the students had knowledge concerning the conservation of matter. Obviously there was something that the students had not discerned. We thought it would be interesting to elaborate this further and also how teaching can be organized regarding the conservation of matter.

The Swedish syllabus describes the concept of matter as central content in school Science. In the Swedish syllabus preamble in Chemistry, it is stated: "Knowledge about the structure and indestructibility of matter provides people with the tools to be able to contribute to sustainable development" (Skolverket, 2011, p.135). With support from the syllabus and earlier research this content is seen as relevant and we decided to formulate an object of learning.

The Object of Learning

The chosen object of learning was: students should develop the ability to explain why matter is conserved even when it changes from one phase to another (phase transitions). We thought that the students needed to discern that in a closed system no molecules are added and no molecules disappear. Actually there are exactly the *same* molecules, with the same weight and size, even when matter changes from one phase to another. This is how we define *conservation of matter*. One purpose of the attempted research lessons was, thus, that the students would discern that a certain amount of matter consists of the *same* molecules and that they retain the same weight and size, regardless of the phase.

Content Analysis

To learn more concerning the object of learning we conducted a content analysis. Andersson (2001) and Andersson et al. (2003) reports on misconceptions from several countries around the world. We thought

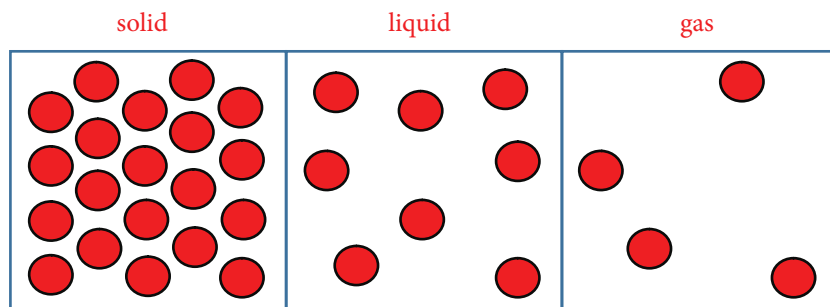
that what these researchers had formulated as misconceptions could be transformed into tentative critical aspects. Critical aspects are aspects of knowledge that the students had not yet been given the opportunity to discern. In addition to the result from earlier research, we discussed our own experiences from teaching and even from the time when we, as students, learned this content.

We asked ourselves questions like:

- What do you know when you understand the conservation of matter when it transitions from one phase to another?
- What do you need to know to grasp the conservation of matter when it transitions from one phase to another?

During the content analysis of the object of learning we also studied the Science textbook used at Hallsta School (Nettelblad & Ekdal, 2006). We analysed the textbook carefully and drew attention to a figure showing the different phases: solid, liquid, respective gas. These pictures are not unique to this textbook – we found similar in other textbooks, for example in Burrows, et al. (2013), Mårtensson (1996) and Sterning (2015).

Figure 2: Phase Transitions Illustrated in Different Textbooks



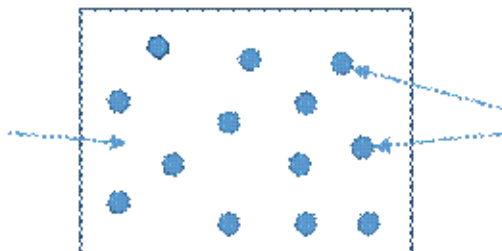
We noticed that the pictures in the textbook showed *different amounts* of molecules seemingly in a closed system. Our reflection was (and still is) that *this* is something which might lead students to perceive that the number of molecules changes when matter, also in a closed system, changes phase. Does a figure like this result in a conception that molecules disappear or are added during phase transitions? This in turn might lead to the conception that the weight changes between different phases. An alternative to pictures such as those in Figure 1 would be three different pictures illustrating the same amount of molecules. The consequence would be three different pictures of different size illustrating each phase, which would correspond better with reality.

Further reflection was (and still is) that most of the pictures in different textbooks usually show water, and its different phases. Water differs from other matters in respect to density. The density is highest in the liquid phase unlike other matters, which are highest in the solid phase. We asked ourselves which perception these pictures will contribute to.

Andersson (2001) and Andersson, et al. (2003) report that students around the world show similar experiences, which are not consistent with the current science. We found it interesting that these experiences exist regardless of the cultural context the students are brought up in.

We also found an example from previous research relevant for our Learning Study, dealing with students' conceptions concerning how a grain of salt is constructed. When students were invited to draw a grain of salt they drew the following picture (Andersson, et al. 2003).

Figure 3: Illustration of Salt



The students in the study by Andersson, et al. (2003) explained that the dots in the picture are molecules and the salt is in-between the molecules. Our interpretation is that students mean: *there are molecules in salt*. Maybe because we express ourselves: *There are molecules in salt*. Other conceptions showed that the dots are the matter (the salt) and between the dots (the salt molecules) there is something else – usually air. Another study from Israel shows that students experience finely divided (powdered) matter, for example granulated sugar or flour, neither as solid nor liquid (Andersson, et al. 2003). This was something that we had not thought about earlier: that students can perceive finely divided (powdered) solid matter as liquid – was this something we had taken for granted? Was it possible that these two conceptions also would apply for our students? Marton and Booth (1997) are writing about different levels of students' understanding of matter. On the lowest level students see matter as a homogeneous substance, not consisting of particles and empty space. On the highest level the students can describe matter as a system of particles and the interaction between them. In one of the lowest levels the students perceive that the particles in some way are

embedded in the material and that the matter is between the particles, for example: between the water molecules there is water (ibid.). Further, other researchers mention different levels or stages in the students’ understanding of particles and empty space.

It is not until relatively advanced learning stages that students assume that the particles in a substance are separated by empty space [...].
(Talanquer, 2009, p. 2130)

Tentative Critical Aspects

Based on research such as Andersson (2001), Andersson et al. (2003), Marton and Booth (1997), as well as from our own experiences, we finally formulated tentative critical aspects, as below (Table 1).

Table 1: Tentative Critical Aspects

Name of the tentative critical aspects	Tentative critical aspects the students need to discern	The students perceive that...
“matter/ molecules”	- that the matter <i>is</i> the molecules (not consist of) - that the molecules <i>are the matter</i>	...in a sealed goblet there are water molecules <i>and</i> water (Andersson, 2001; Marton & Booth, 1997).
“solid versus liquid”	what categorizes solid phase and what categorizes liquid phase	...finely divided (powdered) solid matter is liquid because it is possible to <i>pour</i> (for example granulated sugar or flour) (Andersson, 2001).
“the matter of matter”	what matter <i>is</i> and what it is <i>not</i>	...heat and shadow are matter and that air, living organisms (as human beings and wood) and/ or very small “pieces” (as molecules, dust and cells) are <i>not</i> matter (Andersson, 2001; own experience).
“matter and molecules weights”	that matter has weight and that atoms/molecules have weight	...heat and shadow has weight.

Name of the tentative critical aspects	Tentative critical aspects the students need to discern	The students perceive that...
“unchanged size and weight”	that the amount, size and weight of molecules are unchanged regardless of temperature changes in a closed system	...molecules of water will be more and more and/or bigger/heavier when water changes from liquid phase into solid phase (own experience). ...molecules weigh less when water changes from liquid phase into solid phase (own experience).

In the remaining text, when we refer to the tentative critical aspects and the critical aspects, we are using the “name” found in the first column.

Construction of the Pre-test

Based on the object of learning, *the students’ ability to explain why matter is conserved even when it changes from one phase to another*, content analysis and the tentative critical aspects a pre-test was designed. The written pre-test consisted largely of multiple-choice questions to avoid problems of interpretation when the research group came to correcting the students’ answers. The pre-test consisted also of additional interviews with some students in order to get a deeper insight into how students may perceive the object of learning. The sample of students was based on qualitatively different results from the pre-test concerning the task regarding of the conservation of matter. Item 1 in the questionnaire was designed according to the tentative critical aspect named “matter/molecules” (Table 1). The task was inspired by Andersson et al. (2003) and the previously mentioned study concerning how students perceive how a grain of salt is constructed (Figure 3). The task was also inspired by Marton and Booth (1997) and what they highlight in respect of students’ understanding of matter. However, the research group chose the element water instead of salt, since water is usually what textbooks deal with. In the first item the students were asked to term both the molecules and the empty space between the molecules. When designing item 2, the research group considered the second tentative critical aspect named “solid versus liquid” (Table 1). This item was intended to investigate if the students could categorize different elements as liquid or solid even if it is finely

divided (powdered). The third task was based on the earlier mentioned national test. A picture in the item illustrated a closed goblet with ice cubes and information about the weight. Another picture illustrated the same goblet when the ice has melted into water. The question was: *what is the weight of the goblet in picture two, when the ice has melted?* This was an alternative question with the answers: *a) much less, b) a little less, c) exactly the same, d) little more or e) much more.* This item was followed by another; in almost exactly the same fashion, but concerning chocolate. Finally the pre-test included questions about what matter is or is not and what weighs or not.

Analysis of the Pre-test

All the students took the same pre-test at the same time. The purpose was to take advantage to all qualitatively different answers and perceptions for an analysis before designing the first research lesson. An advantage with all students participating in the pre-test at the same time was also that the students were not able to talk to each other about the content in the pre-test. Results from the pre-test and the interviews did not indicate evidence of knowledge concerning what the conservation of matter means. It turned out that several of the students in the study did not demonstrated knowledge concerning that the weight is unchanged at phase transitions. We found students who perceived that weight changes and become lower when the matter changes from solid to liquid phase or the other way around. We also found students who perceived that the weight changes and becomes heavier when the matter changes from solid to liquid phase or the other way around. Further, we found students that expressed that the weight increases or decreases if a clod of ice is split into smaller pieces (there is air between the smaller pieces).

Critical Aspects

Based on the analysis of the results from the pre-test and the interviews we formulated the critical aspects in relation to the participating students and the object of learning. One of the tentative critical aspects named “solid versus liquid” (Table 1) turned out not to be current for this group of students. Further the research group formulated a new critical aspect named empty space. Empty space was nothing we previously had thought about. The critical aspects this group of students needed to discern in respect to the object of learning are shown below.

Table 2: Final Critical Aspects

Name of the critical aspects	Critical aspects the students need to discern
“matter/ molecules”	- that the matter <i>is</i> the molecules (not consist of) - that the molecules <i>are the matter</i>
“empty space”	that between the molecules there is empty space (not air)
“the matter of matter”	what matter <i>is</i> and what it is <i>not</i>
“matter and molecules weights”	that matter has weight and that atoms/ molecules have weight
“unchanged size and weight”	that the amount, size and weight of molecules are unchanged regardless of temperature changes in a closed system

Principles of Design

Based on the object of learning and the critical aspects we designed the lessons with the help of variation theory.

One of the teachers of the research group held the research lessons, the other members observed and documented the lessons by video- and audiotape, by camera and also took notes. Initially all the lessons started with a presentation of all the adults in the classroom and the purpose of the lesson.

Lesson 1

The lesson was conducted in the following chronological order:

- Initially the students got a statement with different alternatives as to whether weight increases, decreases or is unchanged when ice melts into water. Only one alternative was scientifically accurate, the other alternatives illustrated perceptions that emerged from the pre-test. We wanted to contrast the different perceptions. The teacher noticed the students' answers with the purpose being to use the information later in the lesson. (Critical aspect: “unchanged size and weight”, Table 2).
- The teacher demonstrated the melting of ice cubes in a closed goblet, with the purpose being to demonstrate that the weight does not change when matter changes from solid phase to liquid phase. After the first demonstration the teacher conducted another one, almost identical to the first demonstration, but now the matter was butter instead of ice. We wanted to enable the students to generalize that

the conservation of matter is valid regardless of the type of matter. (Critical aspect: “unchanged size and weight”, Table 2).

- After the demonstrations the students were faced with the initial statement once again. The purpose was to quickly see if any student had changed his or her opinion. Now the teacher used the information from the initial statement and held a discussion with the students about the different perceptions.
- Then the students were introduced to scientifically, relevant concepts: atom, molecule and matter. The concepts and how they related to each other were discussed and explained separately. The purpose was to gain the same understanding for the concepts in the further discussions concerning why the matter does not change weight regardless of the phase. (Critical aspect: “the matter of matter”, Table 2).
- To show that air is *something*, the teacher filled a simple plastic bag with air and squeezed it. The purpose was to demonstrate that air is matter and to initiate a discussion that matter *is* atoms and molecules. The scientific concepts: atom, molecule and matter were used in the discussion. (Critical aspect: “the matter of matter”, Table 2).
- At the end of the lesson the students were involved in a role-play. The students played atoms and molecules, the ambition was that the students should experience and understand atoms, molecules and the empty space. (Critical aspect: “matter/molecules”, Table 2).
- Finally, at the end of the lesson, the students wrote a post-test, identical to the pre-test.

Analysis of Lesson 1 and Planning of Lesson 2

When we analysed the post-test we found that the students still experienced that it is air between the atoms/molecules in the matter. The role-play was not good, and honestly, it *was* air between the students and the exercise did not allow students to discern the critical aspect “empty space” (Table 2). That was why we decided to not have the role-play in the second and revised research lessons.

Since other results in the post-test was good – we chose to keep:

- the demonstration of melting ice cubes and butter,
- the discussion about the three concepts, but we wanted a greater emphasis on matter consisting of atoms and molecules and matter having weight. Even that air is matter (and has weight),
- the questions with the alternative answers,
- the post-test.

We also added:

- a new demonstration with a goblet totally filled with water and a tight-fitting lid. Our intention was to eliminate the airspace in the goblet and initiate a discussion with the students about air versus empty space. The plan was that the teacher would discuss that the goblet was filled with water and that water is the same as the molecules of water. The intention was to contrast that it is emptiness between the water molecules and not air. The aim was to give the students possibility to discern that emptiness is not the same as air (critical aspect: “matter versus atoms”, Table 2).
- a new statement with alternative answers was showed to the students. This statement focused on the opposite transformation, regarding what happens with the weight when matter transforms from liquid to solid phase. This transformation is more difficult to demonstrate during one lesson because of the longer time needed, therefore we were not able to demonstrate this during the research lesson. Since the research group wanted to contrast the two transformations (from solid to liquid phase respectively from liquid to solid phase), maybe this could give the possibility for the students to generalize knowledge in regard to the transformations? (critical aspect: “unchanged size and weight”, Table 2)?
- a demonstration with melted butter, also a discussion regarding what happens to the weight if the goblet does not have a lid – if it is not a closed system.

Analysis of Lesson 2 and Planning of Lesson 3

When we analysed the second lesson and the post-test we found that the students did not discern what matter is and is not (critical aspect: “the matter of matter”, see Table 2). The students did not show knowledge concerning that all matter has weight (critical aspect: “matter and molecules weights”, see Table 2).

The activity we decided to keep intact from the previous lesson was:

- the demonstration demonstrating the melting of ice cubes and butter,
- the discussion about the three concepts,
- the two different questions with the alternative of answers,
- the post-test.

New activities added to the third lesson:

- we showed a picture of water in its three different phases,
- the students wrote one note with one example of something that is matter, and another note with an example of something that is not

matter. The notes were put up on the whiteboard in two columns: “matter” respective “not matter”. The teacher discussed the answers together with the students.

Analysis of Lesson 3

During the third lesson, when the students were to write an example of “not matter” on a note, one student wrote “wood” and sorted the note in the “not matter” column on the whiteboard. Despite the fact that the teacher and the student during the lesson had discussed *what matter is and is not* a student showed this perception (critical aspect: “the matter of matter”, see Table 2). Another result was that several students had discerned that matter has weight (critical aspect: “matter and molecules weights”, see Table 2). An interesting comment from a student was heard during the third lesson. It was during the demonstration of the phase transformation of ice cubes to water. The student said that the weight had increased just a little bit, about 0.00000-something gram, because it had formed some vapour inside the sealed goblet.

Result

In respect to the object of learning, *the ability to explain why matter is conserved even when it changes from one phase to another*, the research group noted that the students before the Learning Study did not demonstrate knowledge concerning conservation of matter.

After the three lessons, in the post-tests (identical to the pre-tests), all the students answered that matter, regardless of the phase, does not change the weight. Was it the demonstrations that convinced the students of the conservation of matter? We do not know if this is a memory skill or if the students know *why* the weight does not change. In the post-tests and in the task with the figure illustrated water molecules several of the students answered that there is “nothing” between the molecules (Figure 3). Is it another indication of memory skills or did the students really understand that it is empty space between the molecules? It would be presumptuous to say that the students really understood this object of learning, maybe the students *could* and *can* explain that matter is conserved when it changes from one phase to another, but do they *really* understand the conservation?

The results from the post-tests showed that most of the students gave examples of what is matter and what is not. The result from the post-tests demonstrated however that some students answered that some matter does not have weight. We cannot express whether the students have a deeper understanding of the conservation of matter, because the

questions during the lessons, during the pre- and post-tests, were more focused on memory skills than understanding the content.

Discussion

A discovery for the research group during the study concerns the pictures illustrating matter in different phases, which is common in many science textbooks. In the earlier mentioned picture (Figure 2) one can clearly see that there are a different amount of molecules, apparently in the same volume, in the different phases. *Can this type of picture develop perceptions that matter actually changes the amount of molecules when it changes phase?* How can teachers relate to this? What is necessary for the students to discern? During the lessons the weight was mentioned, but never the volume or the amount of molecules. Maybe the research group should have used the variation pattern in a different way than we did when planning the lessons? Maybe the students should have had the possibility to discern the volume *simultaneous* with the weight and amount of molecules? Maybe the teacher should more clearly have stating the fact that there are actually exactly the *same* molecules (and not only the same amount)?

Other interesting discoveries were found in the Learning Study. In the study students perceived that air affects matter in two different ways: either air will make matter heavier or lighter. For example during the analysis of the interviews, the same student, who answered that air is matter, answered that a sealed system with ice cubes has less weight than a sealed system with a clod of ice, because it is air between the cubes, which make the ice cubes lighter and therefore the hole sealed system gains less weight. *Did the student mean that the air "lifts" the cubes?* During the interviews we noticed that other students answered the opposite, that the air between the ice cubes, in the sealed system, makes it heavier because of the air. *Do these students know that air has weight?* Do they know that air consists of molecules and that every molecule is structured by its atoms and that every small atom has weight?

During the third research lesson there was a further perception expressed. During the demonstration a student stated as mentioned above, when water in solid phase (ice cubes) was heated on purpose to change it into liquid phase: *Now it is a little bit heavier. Maybe 0.00000-something. I can see there is water vapour up in the goblet.* We have not found this conception in previous research during our Learning Study. Maybe this is a new tentative critical aspect for other teachers to be aware of when planning lessons and for the research group for further teaching concerning the topic?

One critical aspect, which became clear for the research group was that the students needed to discern that air has no impact on the weight of the cubes. Maybe the students had to discern what air truly is? The students also need to discern how matter is built – there is nothing between the molecules but “nothing”. “Nothing” in this context means empty space. Empty space is something that demands understanding on a higher level (Talanquer, 2009). Maybe the knowledge of the empty space is not crucial to understand the conservation of matter, but it may be an indicator that students understand the structure of matter – and thus have the basic conditions for understanding the conservation of matter. This is something that we also found support for in earlier research, for example Smith et al. (2006). They show that molecules change arrangement and or motion but remain intact and therefore the chemical substance remains the same.

When the research group retrospectively reflected on the Learning Study it became clear that *generalization* initially was chosen as pattern of variation. The same phenomena was demonstrated with two different matters with the purpose of showing that matter keeps its weight when melting from solid to liquid phase. According to the variation theory it had been more clear if the variation pattern had been *contrast* in order to demonstrate what conservation of matter *is* and what conservation of matter *is not* (c.f. Marton & Booth, 1997; Marton, 2015). Afterwards the research group also reflected on the fact that the content in the lessons did not clarify the connection between the macroscopic and the sub-microscopic (molecular) level of how particles build up all matter around us (c.f. Vikström, 2014).

Is it possible that this Learning Study contributes insights to other teachers when planning and teaching about conservation of matter? The research group think it is important to be aware of what illustrations and pictures actually demonstrate. An illustration may not promote the intended understanding. It is also important for the students to understand the particle model including the empty space and that it is *exactly* the same molecules (and atoms) involved even when matter changes from one phase to another phase and therefore the matter has the same weight. Finally we think that it may be interesting to find out how students perceive air and how air affects other matter?

The students from lesson one (Grade 6) made two delayed post-tests, the first one a month after the lesson and the second delayed post-test further two months later. All of the students answered, both times, that the weight did not change when matter change phase indicating a firm understanding.

References

- Andersson, B. (2001). *Elevers tänkande och skolans naturvetenskap, forskningsresultat som ger nya idéer*. [Students' thinking and the natural science in school, in Swedish], Stockholm: Skolverket.
- Andersson, B., Bach, F., Frändberg, B., Jansson, I., Kärrqvist, C., Nyberg, E., Wallin, A., & Zetterqvist, A. (2003). *Att förstå naturen – från vardagsbegrepp till kemi*. [Understanding nature – from everyday concepts to chemistry, in Swedish], Sex 'workshops'. Göteborg: Enheten för ämnesdidaktik, IPD, University of Gothenburg. Collected 2015-09-28: https://gupea.ub.gu.se/bitstream/2077/10628/1/gupea_2077_10628_1.pdf
- Burrows, A., Holman, J., Parsons, A., Pilling, G. & Price, G. (2013). *Chemistry³. Introducing inorganic, organic and physical chemistry* (2:a edition). Oxford: Oxford University Press.
- Marton, F. (2015). *Necessary Conditions of Learning*. Oxon & New York: Routledge.
- Marton, F., & Booth, S. (1997). *Learning and awareness*. New York: Routledge.
- Mårtensson, G. (1996). *NO Kemi* [Natural science, Chemistry, in Swedish]. Malmö: Gleerups Utbildning AB.
- Nettelblad, F. A., & Ekdahl, C. (2006). *Spektrum Kemi* (3:e Edition) [Spectrum Chemistry, in Swedish]. Stockholm: Liber.
- Smith, C., Wiser, M., Anderson, C., & Krajcik, J. (2006). Implications of Research on Children's Learning for Standards and Assessment: A Proposed Learning Progression for Matter and Atomic-Molecular Theory. *Measurement*, 14(1-2), 1–98.
- Skolverket (2011). Curriculum for the compulsory school, preschool class and the recreation centre 2011. Stockholm: Skolverket.
- Skolverket. (2012). *Att se helheter i undervisningen. Naturvetenskapligt perspektiv*. [To see wholeness in teaching. A perspective on natural science, in Swedish], Forskning för skolan. Stockholm: Skolverket. Retrieved 150928: http://www.skolverket.se/om-skolverket/publikationer/visa-enskild-publikation?_xurl_=http%3A%2F%2Fwww5.skolverket.se%2Fwtpub%2Fws%2Fskolbok%2Fwpubext%2Ftrycksak%2Fblob%2Fpdf2790.pdf%3Fk%3D2790
- Sterning, G. (2015). *TitaNO Kemi* (2:a Edition) [TitaNO Chemistry, in Swedish]. Malmö: Gleerups Utbildning AB.
- Talanquer, V. (2009). On Cognitive Constraints and Learning Progressions: The case of "structure of matter". *International Journal of Science Education*, 31(15), 2123-2136.
- Vikström, A., Billström, A., Fazeli, P., Hansson, G., Holm, M., Jonsson, K., & Rydström, P. (2013). Teachers' Solutions? A learning study about solution chemistry in grade 8. *International Journal of Lesson and Learning Studies*, 2(1), 26-40.
- Vikström, A. (2014). What makes the difference? Teachers explore what must be taught and what must be learned in order to understand the particulate character of matter. *Journal of Science Teacher Education* 25(6), 709-727.

CHAPTER 6

Framing the Cases of Vocational Skills versus Home and Consumer Studies in Tanzania and in Sweden

Gunilla Höjlund, Viveca Lindberg & Kalafunja Osaki

Chapters 6.1 and 6.2 present and discuss two Lesson Studies within two primarily practical subjects and in relation to food preparation i.e. learning to make bread using wheat flour in a Tanzanian school (Makulu Primary School, Dodoma Municipality) and learning to make a soup using the adequate utensils in two Swedish schools (Sofia and Maria, Stockholm Municipality). There are few vocational Lessons and/or Learning Studies thus these two might give insight into the challenges of so-called practical Lesson and Learning Studies.

Learning to make various types of bread is content within the Tanzanian subject Vocational Skills and the subtopic of cookery (MoEVT, 2005). The subject aligns with the long lasting tradition of including different elements of vocational training and practical work activities in general schooling not only at primary level but also at secondary level. This tradition has formed an important strategy within broader educational policy corresponding to the socialist state ideals established 50 years back, namely “education for self-reliance” (Höjlund, 2006). Education was looked upon as having a key role in fostering the young generation to live and work together from the perspective of common good and in preparing for the

kind of work youngsters would most likely get i.e. farming (Nyerere, 1967). The vocational elements in the otherwise general schooling originally included subjects such as agriculture and animal husbandry at primary school level, technical, commercial and home economic biases in secondary school and production activities at all levels of the education system (Höjlund, 2006). The latest representation in primary schooling, Vocational Skills or *Stadi za Kazi*, was introduced in the 1995 Educational Policy and revised ten years later in the 2005 curriculum reform which forms the base of the study presented. The subject initially comprised 19 occupational fields comprising specific vocational skills that were said to correspond to common crafts and trades across the country including artistic, service, production and crafts fields (MoEC, 1996). The 2005 syllabus reduces the skills fields to eleven; the more technical fields are excluded, for example plumbing, electrical installation, radio repair to mention some. At the same time a few new fields were introduced such as petty business, shoe and bicycle repair and fishing. Research on the implementation pointed to poor skills development in the schools and called for a change to better adjust to what actually was taught and learnt (MoEVT, 2005; Höjlund, 2006; Osaki, 2009).¹⁰

Tanzania is one of a few countries, which for a long time has kept a comprehensive vocational education program within primary school while a country like Sweden retains non-vocational subjects like Arts, Music, school handicraft (*Sloyd*) and Home and Consumer Studies. The latter is the focus here. Home and Consumer Studies as a school subject for girls in public school was implemented at the end of the 19th century. Initially this subject was intended for working class girls, who were expected to learn to choose and cook nutritionally good and economically valuable food in a hygienic way. The development of Home and Consumer Studies must be interpreted in the light of the success science had in society regarding nutrition and hygiene (Grönqvist & Hjalmeskog, 1998). Further arguments that supported the implementation of this subject into the Swedish curriculum for public school was that Home and Consumer Studies, as well as school handicraft, Arts and Music, formed a practical contrast to other subjects primarily based on reading, writing, and memorizing (Borg, 2006).

¹⁰ By the Education Policy of 2014 and the followed curriculum reform 2016 the subject is expected to be taught in Standard V and VI and the skills fields are reduced to four namely personal hygienic habits, food preparation, arts and handicrafts and entrepreneurship (MEST, 2016).

Moral and ethical arguments related to the enhancement of virtues like diligence and working-spirit were also used for these practical subjects (Grönqvist & Hjalmeskog 1998). However, the background for Home and Consumer Studies as a schools subject in public school and as a basic vocational education for young women must also be related to a wider context. Early in the 20th century there was a home economics movement in the U.S.A. (Wilmarth & Nickols, 2013) and in Europe (Turkki & Vincenti, 2008). However, the emergence of Home and Consumer Studies should also be interpreted in light of sociological categories like gender, social class, and race, and thereby of importance for women's access to education, work, and professionalism (Stage & Vincenti, 1997).

Today, the purpose of the subject Home and Consumer Studies is "to give students important tools for creating a functioning daily reality, and the ability to make conscious choices as consumers with reference to health, finance and the environment" (Skolverket, 2011, p. 43), a purpose that neither specifically aims to be a base for further studies nor prepare for the labour market, but rather prepare students as citizens. In contrast the Tanzanian subject Vocational Skills at the time of the study remained with the twofold purpose of preparing for self-employment as well as preparing for further Vocational Studies.¹¹

[T]he objective is that the learner develops basic vocational principles and skills in various fields that will enable him/her to develop means of living after completion of primary schooling especially in the informal economy as well as to pursue further studies in vocational training after completion of primary schooling. (MoEVT, 2005)

When it comes to the syllabi for the two case studies, the two disparate subjects concerned in this project makes a comparison of syllabi rather difficult. At the time of the study, the Tanzanian Vocational Skills syllabus encompassed as mentioned eleven vocational fields. Instructions to schools concerning Grade 6 was that five compulsory skills areas should be taught; one of them was to be cookery. Home and Consumer Studies constitutes one comprehensive subject and core content in Grades 1-6 are three broad areas: (i) Food, meals and health (for example recipes and instructions, how they can be interpreted and followed, as well as different methods of baking and cooking); (ii) Consumption and personal finance; (iii) Environment and lifestyle. Based on these syllabi

¹¹ The Education Policy of 2014 and subject syllabus from 2016 for the first time break with this twofold purpose and focuses on skills for daily life as citizens.

prerequisites one common competence was identified: cooking different types of food following basic cooking principles, forming the base for the two cases.

Even though the countries share many recurrent challenges to education on a policy level the social and economic context for teaching and students' learning shows the unfathomable differences between the conditions for teaching in these two cases. The challenge as described in the Tanzanian case of large classes, lack of materials, equipment and facilities forcing teacher to purchase materials and ask for students' contribution is specifically difficult in schools in poor communities. In contrast, the Swedish schools have fully equipped small kitchens for students to work in groups of three to four, and choosing the accurate utensil for various purposes has become knowledge in itself.

Both cases presented in the following were designed more in relation to the model of Lesson Study than as a Learning Study. However, both cases used the two central concepts of Learning Study: object of learning and critical aspects.

References

- Borg, K. (2006). What is sloyd? A question of legitimacy and identity. Special issue: Sloyd-tradition in transition. *Journal of Research in Teacher Education*, 13(2–3), 35–51.
- Grönqvist, M. & Hjälmeskog, K. (1998). *Hemkunskap – betraktat ur ett didaktiskt perspektiv* [Home economics – a didactics perspective, in Swedish]. Uppsala www.did.uu.se/hkrummet/didaktikbok98.
- Höjlund, G. (2006). *Vocational skills formation in communities of practice. Experiences from primary school and the informal economy in Tanzania*. Stockholm Institute of Education Press
- Ministry of Education and Culture (1996) *Vocational Skills syllabus for primary schools Standard I – VII*. Tanzanian Institute of Education.
- Ministry of Education and Vocational Training (2005). *Vocational Skills syllabus for primary schools Standard I – VII*. United Republic of Tanzania
- Ministry of Education, Science and Technology (2016). *Vocational Skills Syllabus for basic education Standard V to VI*. United Republic of Tanzania
- Nilsson, L. (1981). *Yrkesutbildning i nutidshistoriskt perspektiv: Yrkesutbildningens utveckling från skråväsendets upphörande 1846 till 1980-talet samt tankar om framtida inriktning*. [Vocational education in the perspective of contemporary history: the development of Swedish vocational education since the abandonment of the guild-system until the 1980s and some thoughts on future directions, in Swedish] Göteborg studies in educational sciences, 39. Göteborgs universitet. (doctoral thesis).
- Nyerere, J (1967): *Ujamaa- essays on socialism*. Dar es Salaam, Oxford University Press.

- Osaki, K, M. (2009). *Towards a relevant education for science and mathematics, language and skills development in relation to existing market demands*. Annual Education Sector Review, Ministry of Education and Vocational Training. [MOEVT]. Dar es Salaam.
- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011: Lgr11*. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Stage, S. & Vincenti, V.B. (1997). *Rethinking Home Economics: Women and the History of a Profession*. Ithaca & London: Cornell University Press.
- Turkki, K. & Vincenti, V.B. (2008). Celebrating the Past: A Critical Reflection on the History of IFHE and the Home Economics Profession. *International Journal of Home Economics*, 1(2), 75 -97.

Chapter 6.1

The Tanzanian Vocational Skills Case – Baking Bread

Kalafunja Osaki & Flora Mbembe

Introduction

The study was carried out at Makulu Primary School – an old village school established already by 1954. About 1 200 students were enrolled at the concerned school year (2014-2015). Class six students were involved in the Lesson Study. Originally the Makulu village was a farming village but the small farms have been eaten up by municipality constructions. This has meant that parents have had to seek jobs elsewhere and left the children to the grandparents.

Before starting the project, the research team visited Makulu Primary School in order to introduce themselves and seek teachers' interest in participating in the project. The researchers interviewed the teachers and head teacher on the state of Vocational Skills teaching and learning at the school. It was discovered that there were twelve teachers involved in teaching Vocational Skills in the whole school and that the subject was compulsory from Grade 3 to 7. The project was introduced to the acting head teacher Mr Jackson Lameck who among others selected three Vocational Skills teachers to work with. These were teacher Ms Nyamtunde, Ms Wanjara, Lameck and Ms Habiba Chwurah. After a brief discussion with the head of the school, deputy head and Vocational Skills teachers it was noticed that the project was of great

interest to students since most of the time the teachers struggled with how to teach the content in this subject but had little guidance on how to proceed. During our conversation the teachers claimed that, by its nature Vocational Skills is a subject that needs to be taught practically. Teachers acknowledged that despite their understanding this, most of the time this was not the practice. They gave reasons such as a lack of facilities for conducting such lessons, and shortage of funds to purchase resources for preparation and presentation. They gave a few examples:

- In teaching about baking and cooking the lesson required them to purchase necessary requirements and ingredients to be used when baking/cooking and also equipment including pots, stoves etc. They also needed to provide an opportunity for students to practice at least in groups. There were no funds to purchase any teaching resources and hence these opportunities to students were not practicable.
- Another challenge was fear of failing to fulfil what was planned in the heavily packed curriculum. There were lots of things, which needed to be taught in limited time. Making all lessons practice oriented means that only few topics would be covered. This was also compounded by the large number of students in a class, which makes management of learning activities very difficult for the teacher.
- The large class sizes are illustrated by the situation in Grade 6, in 2014, where there were 100 students. To teach such a class practically was difficult in terms of classroom arrangements, group management, determining current knowledge of the learner, lesson delivery and improving learners' understanding of the lesson.
- It was noted that, most of the time when the lessons were conducted practically, teachers voluntarily incurred the cost of bringing to school some of the requirement from their homes. Learners also incurred some costs, since they had to contribute some money to purchase basic ingredients. When learners were unable to do so, teachers resorted to simple demonstration or lecturing which negatively affected learning.

Identification of the Teaching Topic

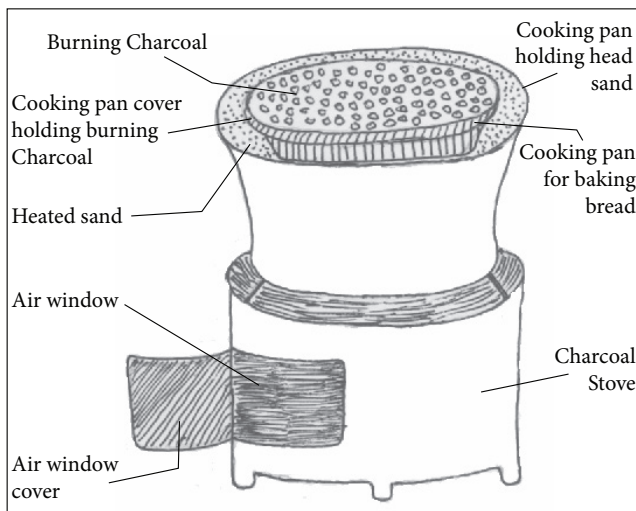
The need to prepare the lessons on baking of bread was identified by the teachers themselves since this was a lesson that students rarely learned practically although they could use this knowledge and skill to do small-scale business after school. They normally learned the theory of it from the teacher and wrote down some notes in their notebooks.

Students also were interested to eat bread but few of them knew how it was made.

The students attending Makulu are mainly from a relatively poor community. In terms of consumption of bread, few families would afford to buy bread. In place of bread most of them eat stiff porridge made from millet, sorghum or maize meal, or sweet potatoes, cassava, or fried bananas. However, most children would like to know how to make bread as the culture was changing and they would be able to sell bread in their local community. It was also important to experiment with how to make bread by using local ingredients including maize, sorghum or millet flour. Thus in Vocational Skills this would broaden their knowledge and skills on how to make varieties of foods for their families and communities or for sale.

It was agreed with the three teachers that we would reflect with teachers and students on baking needs for the community and design lessons on bread baking using wheat flour. One teacher said that even millet could be used for baking bread but after discussing this, we agreed that since wheat flour was abundant in the shops, we were going to use wheat instead of millet. Based on the home environment of most learners, it was agreed to use a charcoal stove and heated sand as an improvised local oven, because gas cookers were expensive to obtain and electrical cookers would be problematic since most children did not have electricity at home. Figure 1 illustrates a sample of this improvisation

Figure 1: Improvised Oven



Potential Critical Aspects

Before designing the first lesson we had a discussion with the teachers on potential critical aspects for the students to discern. The critical aspects as identified by the teachers to emphasize before we started the first lesson were that students should discern the following:

- i) the proportions of water, flour, bakers yeast and salt to produce the dough, and the meaning of stirring them gently,
- ii) the characteristics for when the dough is ready for starting to bake,
- iii) the different steps needed for making the oven ready for baking,
- iv) how to control the temperature of the oven when baking, and
- v) the characteristics of when the bread is ready, and knowing how to test this.

In collaboration with the three teachers, questions for mapping students' knowledge were made and administered to students. This included a classroom paper and pencil pre-test and a focus group interview. The intention of these was to determine students' prior knowledge, prior skills and experience of bread baking and also to explore difficult areas in understanding the bread baking process.

The pre-test results revealed the following:

- Most students were missing lived experience of bread baking because bread is not usually made or consumed in poor families' homes.
- In a sample of 40 selected students, only 5 students (3 girls and 2 boys) reported to have an idea of bread baking mainly from their elders at home.
- Out of these, only one student (a girl) reported to have once prepared a loaf of bread at home, though she failed to explain clearly the step-by-step procedures used in making bread.

From their responses and the experiences of the teachers and the research team the lesson was planned and designed. The focus on teaching was placed not on performance in examination but on developing the skills of baking bread as learned in the class in the outside environment.

Lesson Design and Lesson Cycles

In the lesson design, the following objects of learning and critical aspects were considered.

Object of learning

The students should be able to

- mix water and flour in order to make dough to the right standard,
- set up, equip and manage the local oven, and
- be able to prepare bread for family use or for sale

Based on the mapping, we concluded that the potential critical aspects we had assumed, as mentioned above, were all relevant; that is, students needed to discern:

- the proportions of water, flour, bakers yeast and salt to produce the dough, and the meaning of stirring them gently,
- the characteristics for when the dough is ready for starting to bake,
- the different steps needed for making the oven ready for baking,
- how to control the temperature of the oven when baking, and
- the characteristics of when the bread is ready, and knowing how to test this.

The First Lesson

In order to be able to handle 100 students, we planned the first lesson for a smaller group with one teacher, Ms Wanjara teaching the lesson and using participatory methods including brainstorming, questions and answers, demonstrations and practice. The lesson was taught to only 20 randomly sampled students with the purpose of providing data for this study. After introducing the theoretical aspect of bread baking and demonstrating all the necessary steps of the lesson, learners were divided into groups of 10 where they were involved in the actual practice of bread baking. In the process of learning, the learners were highly engaged. Following teachers' guidance they baked bread practically step by step. In the class, learning was monitored with the support from two other teachers and the researcher through observation to look at practices of students in bread baking and see what difficulties they were having.

In the preparation of dough, most students observed one or two members mix the water and flour. They stirred in turn and added more flour until the dough was to an acceptable standard, that is, both smooth and elastic. In order to identify the meaning of this, one has to assess the dough both visually and by how the dough feels when touching it with the wooden spoon. Some would say: it is now ready, let us ask the teacher, but when the teacher came he would advise to continue stirring a little more or to now stop stirring – experience is needed for being able

to identify what characterises a dough that is both smooth enough and elastic enough.

Figure 2: A Group Following Preparation of Dough for Bread



Figure 3: Preparing Dough for the Local Oven



In getting the oven ready, students would set up the charcoal cooker; add charcoal and light it and wait until the charcoal was well burnt and ready to start working. In controlling the temperature they had to learn how to put some charcoal on top of the oven when the dough was inside and reduce charcoal pieces when they saw the bread was close to being cooked.

Figure 4: Local Ovens in Use for Baking Bread



In testing if baked bread was ready they had to take one loaf out and cut it into pieces for each one to test and feel satisfied that it was ready or not, based on whether it was still sticky (not ready). While this was going on the teachers were passing around the groups to assist them make appropriate decisions at each stage. By the end of the lesson the students under guidance of their teachers had managed to bake good wheat breads of two shapes (round and scones) using a charcoal stove as the oven. Figure 5 shows the final product.

Figure 5: Baked Bread From the Group Tasks



Students tasted the bread and felt happy that they had produced eatable bread and learned how it was made.

Post-test

After the class lesson a post-test was given to students. Questions for the post-test were the same as those of the pre-test. Results of the post-test indicated that, the students who took part had mastered the lesson to a large extent. Girls showed a greater improvement when compared to boys. On the other hand it was noted that some of the students had a problem with the following:

- Remembering all the requirements and procedures for bread baking was a problem for some students;
- Estimating the proportion of ingredients to use (how much flour, water, salt etc.) in making a selected number of bread loaves.

The second lesson

From the above observation lesson two was designed and conducted with the aim of improving learners' learning experience, which in turn improved the acquisition of basic bread making skills. Among the changes made during lesson 2 after lesson 1 were: spending more time in the pre-lesson discussion by students to allow more time for discussing the critical aspects initially identified by the teachers and also to allow them more time to talk about the process as they were mixing flour and water, getting the oven ready, determining time required until bread was cooked. More participation by shy students also increased participation as the teacher and researcher collaborated to pass round and encourage the groups.

Lesson two with the whole class was taught by the same teacher in the same class with modification of time for pre-lesson discourse and support in supervision. The students were given the test with the same questions as those asked earlier. Based on the test result the designed lessons seem to have helped the students acquire knowledge and skills since it showed a trend of improvement from the first to the final test.

The third lesson

The above lessons were conducted during the year 2014. In 2015 the new Grade 6 class was involved in the study. These were new students because Grade 6 learners of 2014 had gone to Grade 7 in 2015. The essence of having these new students was to try to change the approach of teaching. Instead of teaching the large class, a few students (only 10)

were randomly selected to test the effect of a smaller class size. These were given a written pre- and post-test. Also, they were given a final oral interview concerning the baking requirements and ingredients. In the interview learners were required to give a brief explanation of baking bread step by step using the available materials. Out of 10 students only one failed to correctly describe all the correct procedures of bread baking. This led the researcher to conclude that this class has shown a greater immediate achievement when compared to the previous class. The teachers and researcher also learned that they had improved the learning experience of the students.

Using this small class the difficulties of teaching were highly minimized and learners showed better learning and performance in the written post-test after only one lesson. This might have been contributed by the smaller class size, which facilitated helping each learner and encouraging smooth teaching and learning. From the experience of class management obtained in the previous lesson 2 and the reduced class size, it was possible to provide more support to smaller groups and hence each student had greater opportunity to focus on the process.

Discussion: Lesson Study and School Development

The experience of running these lessons has taught both the teachers and researchers the following:

- That Lesson Study can be used to understand learning difficulties and improve lesson design. In this case the group taught in 2014 gave us the experience on a more effective way to organise the lesson, reduce class size, and monitor learning such that most students acquire a mastery of baking;
- That we can actually improve achievement of the object of learning through this kind of research, through closer support of student group tasks;
- Knowledge of the critical aspects – that which must be discerned – is absolutely essential for teachers to be able to enable learning to occur, as was the case in the second group of 2015 in this study; and
- School development evolves out of this realization that it is in ensuring that objects of learning are achieved and students reach critical aspects during learning. In our case we hope to encourage that the teachers we have worked with will use this approach to now teach other topics in the syllabus such as frying, cooking, tailoring, sewing, weaving and sewing.

Chapter 6.2

The Swedish Case – Choosing and Using Kitchen Utensils

Carole Pardue, Eva Mårtensson & Viveca Lindberg

Home and Consumer Studies is a subject in Swedish compulsory school in which students learn about food preparation and also how to make conscious choices as consumers with reference to health, finance, and the environment. Food preparation in Sweden usually takes place in well-equipped and well-stocked kitchens with a recipe as a guide. The home kitchen is the basic model for the school kitchens. Furthermore, technology and design in combination has contributed to development of utensils specially designed for various techniques and methods for preparing vegetables, meat, fruit etc. depending on the type of dish to prepare. The choice of utensils when cooking thereby directly influences the result, the time it takes to complete the task and the ease of the work, as well as food quality and waste – all quality aspects of students' knowing in the subject Home and Consumer Studies. So the question for us as teachers (Carole Pardue and Eva Mårtensson) was what students need to know and discern in order to choose utensils, which would allow them to work more effectively and thereby improve their result. This was the point of departure for our study.

Introduction

Maria School and Sofia School are situated in Stockholm City. Both schools were built around 1890 and have approximately 1000

students aged from 6 years old to 16 years old. The subject Home and Consumer Studies (HCS) is taught in the sixth (12 years old), eighth (14 years old) and ninth (15-16 years old) school years. In both schools Home and Consumer Studies are held in half-classes (usually 12-15 students) once a week, during one term per school year. The lessons are 120 minutes long.¹²

Our schools, like most others in Sweden, are equipped with specially built HCS classrooms which have space for the students to sit and write or eat the food they prepare, as well as a number of well equipped kitchen units in which they can practice food preparation in groups of two or three students per kitchen. Each kitchen contains a sink unit, modern electric stove/cooker, working surfaces, cupboards and drawers with a selection of pans, cooking utensils etc. (see Figure 1).

Figure 1: The School-Kitchen with Eight Units



The teacher, who has a budget for this, orders suitable ingredients for the various lessons from a store and each group of two or three students gets sufficient ingredients to make their own meal according to the recipe provided.

Some of the lessons in HCS are practical, for example food preparation, cleaning and home care and some are theoretical, for example various aspects of consumer issues, depending which core content and ability from the HCS curriculum is in focus in each particular lesson.

¹² According to the *Ordinance on the Compulsory School System announced in the Code of Statutes* (SKOLFS 2016:553, Attachment 1) Home and Consumer Studies should comprise 118 hours total in the compulsory school.

Aims

The aim of this study was to examine and develop teaching practice in the subject Home and Consumer Studies with special focus on the choosing and use of kitchen utensils. Based on previous classroom experiences that a large number of our students have not recognised the importance of using the correct implements in spite of teachers' frequent reminders, we identified a need to improve students' understanding of the way their choice of utensils can influence their results and facilitate their work with food preparation. The ability to choose and use kitchen utensils related to specific techniques, with a vegetable soup as the practice exercise, the object of learning for this Lesson Study. The importance of correct use of utensils is also emphasised in the knowledge requirements for Home and Consumer Studies in Swedish compulsory schools:

Pupils can plan and prepare meals and carry out other tasks related to meals, and do this with good adaptation to the requirements of the activity. In their work, pupil can use methods, food and tools in a well functioning and safe way. Pupil can also make well-developed assessments of work processes and results. In addition, pupil can apply well-developed reasoning to producing varied and balanced meals. (Skolverket, 2011, p. 48)

The issue for this Lesson Study is firstly, what students need to know and discern in order to choose utensils, which allow them to work more effectively and thereby improve their result, and secondly, how teaching can be structured to make it possible for the students to develop their skills in relation to the object of learning.

Background

We assume that there are several different factors, which can influence students' choice of utensils. Assumedly, instruction from the teacher is one, but familiarity with cooking practice at home and the influence from friends can also be major factors.

In Home and Consumer studies in Sweden it is partly tradition and partly function that decides which utensils are correct for different tasks. One example of this is the choice of a knife. A kitchen knife is used to cut, chop and slice. It is particularly suited for these techniques because of its (usually) sharp blade and shaped handle. We associate knives with cutting motions.

Figure 2: Examples of Kitchen Utensils that the Students are Supposed to Know by Name and Function



One of the unsuitable uses of a knife, which we have seen, is to stir a hot sauce in a saucepan. It is unsuitable because the sharp knife can damage the saucepan, but also scrape metal fragments into the sauce. Furthermore, the blade is too narrow to move the sauce around in the pan, since the reason for stirring a sauce is to create a homogenous mixture. A wooden spoon, on the other hand, works very well as it is designed for stirring – it is easy to reach the sides and corners of a pot or pan.

The utensils we use in HCS are usually simple basic implements, which have established associations with certain techniques. However, new kitchen equipment is constantly being designed and produced. Some of these new ones will eventually be part of the food preparation tradition in the home, and will change current conceptions of what is most functional.

Understanding why a certain utensil is used for a certain task or technique is not always obvious to students. Teachers need to consider how to best introduce utensils and their areas of use so that all students can improve their technique and work in an effective manner.

Research Process

To enable us to plan for instruction, which would result in students being able to choose and use utensils correctly, we decided to start with two test lessons with varying introduction to the content. These lessons were carried out during spring 2014. Each lesson was held in a different Grade 6 class (12-13 year olds), one in Sofia School and one in Maria School. These lessons were held some weeks into the term and were therefore not the students' first experience of cooking. The

purpose was to map how students' choice of utensils worked in practice. In preparation for these lessons, we discussed how we usually present the utensils and method of food preparation for the students, and how they then use it in their work in cooking and baking.

These lessons, as well as subsequent lessons, were video-recorded so that we could, after the lessons, watch several times how the students worked and thus more easily discuss, compare and analyse what happened in each of the groups. According to school and Swedish ethical rules for research (Vetenskapsrådet, 2017), permission was obtained from the parents to video-record the children. The number of students in each class for the test lessons varied, but in both schools the students worked in pairs in each kitchen (see description of the classroom above). The lessons were video-recorded by the teacher who was not teaching and were analysed by both of us together.

The main issue for the Lesson Study was to explore what kind of instruction would result in students' informed choices of relevant utensils for cooking. In preparation for the research lessons, we discussed how to design the presentation of the utensils and method of food preparation for the students. In total four variations on the basic lesson were carried out.

For the lessons, we chose a vegetable soup for the students to cook, because the preparation involves several different preparation techniques with different kinds of utensils. These preparation techniques were specified in the recipe. We also wanted the students to familiarise themselves with these techniques as they are common to many different dishes.

The recipe, (see Figure 3), was copied and handed out to the students. All three lessons were based on the same recipe, but we varied our oral and written instructions to explore how different kinds of instructions influenced the students' work. After each lesson the students filled out an assessment form.

Research Lessons

In the following, we initially describe how each of the three lessons was designed. Each lesson was taught with the same recipe (Figure 3) but the teacher's instructions to the students varied, and for each lesson different groups of students were taught.

Figure 3: Recipe for Vegetable Soup. *Words such as Peel, Slice, Chop, Stir and Grate, Included in the Recipe, Describe Different Techniques, which are Connected to Specific Utensils

Recipe

5 dl water
 1 big potato or 2 small ones)
 ½ medium size onion
 1 small carrot
 ½ parsnip
 50g celeriac
 50g swede
 2 tsp. bouillon powder
 A pinch of salt
 Half a pinch of pepper
 A pinch of dried thyme (crushed)
 Some chopped parsley

Method

1. Heat the water in a saucepan.
2. Peel* and slice the potato, add them in the saucepan.
3. Chop the onion, add these too. Stir and heat to cooking.
4. Peel and slice the carrots and the parsnip, add to saucepan and stir.
5. Peel and dice the swede into small pieces, grate the celeriac and stir these too into the soup, Heat to boiling.
6. Stir the bouillon powder in to the soup, add salt and pepper. Crush the thyme and add to soup. Heat to boiling.
7. Boil for 5 minutes. Season if necessary.
8. Ladle the soup into bowls and sprinkle with chopped parsley
9. Serve the soup with a table spoon of Crème fraîche

After the introduction, the regular procedure is that before starting to prepare food students wash their hands, a hygienic requirement, put on aprons to protect their clothes from possible stains, and go to their kitchen stations and prepare the food of the lesson. When the food is ready, they eat, wash the dishes and clean the kitchen. In the following section we describe the observations of students' work related to three types of instructions.

After the initial description of the design for each lesson follows observational descriptions of the respective lesson.

Test lesson 1

In the beginning of the first test lesson we handed out the recipe to the students without any specific instructions about utensils and techniques,

but let them prepare the vegetable soup according to the recipe as best they could. The students, in their work groups were allowed 10 minutes to read through the recipe and discuss how they would organize the work and also which utensils they would use. If they needed help, they were instructed to first ask their workmate, before they called on the teacher. At the end of the lesson students filled in an evaluation form aiming at guiding the teachers in further developing their teaching.

Observations: Although the assignment was introduced as a group-work, we noticed that most of the students read through the recipe quietly on their own. None of them discussed it with their workmate before they began work; instead they went directly to the kitchen and began work. When they got into the kitchen they collected their ingredients according to the recipe. Utensils were chosen and taken out of drawers and cupboards gradually as they worked their way through the instructions in the recipe. The students were not particularly focused on utensils, but more on what they were producing. They often peeked at each other's preparation methods. There were several varieties in their techniques in different kitchen stations. For example, though the recipe said slice the carrot one group grated the carrot, another chopped them, a third cut slices and a fourth cut large chunks.

We discovered that several of the students did not follow the recipe and the instructions that were given in it which resulted in the soups being varied in their amount and appearance. Some groups used less of certain vegetables and some did not follow the order of preparation in the recipe. This resulted in some of the vegetables being undercooked. Also the time needed for finishing their work varied between the groups.

Test lesson 2

The second test lesson began with the teacher handing out the recipe and then reading it aloud for the students. They should then follow the text and when the teacher came to a preparation technique, students were asked to suggest a utensil suitable for the respective techniques. They agreed that the largest knife, the chef's knife, was suitable to use when slicing potatoes and root vegetables. However, when peeling potatoes and root vegetables it was suitable to use a potato peeler or a small vegetable knife (Figure 4).

Observations: During the introduction of the recipe students participated in varying degrees. Several suggested utensils for the different techniques, some gave no answers at all. In this lesson also, we

noticed that the students collected their ingredients when they got to their workstations, whilst the utensils were taken out as needed during the preparation process, though they had been instructed to do this before starting work.

We noted that the students seemed to understand what they should do and did not hesitate to think about the recipe as often as those in the first test lesson. The techniques they used were usually correct, which can indicate that they felt more confident in their procedure after the recipe had been discussed. However, there were some differences in the groups when it came to which utensils they chose, compared to the utensils that had been discussed and recommended during the introduction. For example, in two of the groups students did not use the types of knives, which the class agreed upon in the introduction. Two students did not peel vegetables; though a peeler was discussed in the introduction and a third student used a cheese slicer to peel the carrots.

Figure 4: Potato Peeler and a Typical Swedish Cheese Slicer



As in the previous test lesson we discovered that several of the students did not follow the instructions given in the recipe regarding techniques related to utensils. As in the first research lesson, the quality of the soup varied between groups: some forgot to season the soup, which affected the taste, others had not followed the techniques given in the recipe and thereby some vegetables were undercooked.

Research lesson

In the second test lesson, preceding the research lesson, the preparation techniques linked to the utensils were discussed. At the beginning the recipe was again handed out and was the main reference material for the introduction. Instead of instructions by the teacher, the teacher orchestrated a discussion with the class about the reasons for including vegetables in our diet: their nutritional values, taste and colour, and economy – vegetables are cheap food. Then the teacher read through the recipe stage for stage and asked the students what the different preparation terms meant and which utensils were suitable for the techniques related to each phase of preparation. In order to give everyone in the class a chance to think through and show what they knew, each student was restricted to maximum three answers. Sometimes there was a short discussion in the group before they agreed on the final answer.

This time, the recipe sheet was complemented by a large square with two headings: “Utensils” and “Used for”. The teacher explained that every work-group, when they went out to the kitchen stations, and before starting to prepare the soup, must agree on what utensils and equipment to use in relation to the recipe and then write in the square what each of them was called and what they would be used for. Another change for the research lesson was that two of the questions on the evaluation form were reformulated as we had found they did not contribute to the information needed as to critical aspects related to the object of learning.

Observations: When the students started working, they laid out their utensils on the workbench. There were lively discussions at several kitchen stations about which utensils were best for the task and what some of them were called. The students seemed concentrated and interested in the square in the recipe sheet and those working together in their groups helped each other with the answers. We noticed that overall the students checked the recipe more often than in the test lessons and that they checked with each other in the groups that they really had used

the utensils that had been written in the square for the tasks they had written beside them. Both teachers checked the lists of utensils in the squares and helped those who had missed something. The result was that the soup was ready in a shorter time and with improved quality (all the vegetables were cooked through), than in the test lessons, which gave more time for eating and filling in the evaluation forms, as well as finishing tidying up.

Comparative Analysis

All lessons were analysed by comparing similarities and differences (Palmberger & Gingrich, 2014) regarding aspects related to conditions for (teaching) and aspects of students' work processes related to uses of utensils as well as the techniques – peeling, chopping, slicing, dicing and grating – related to each utensil. Furthermore, the evaluation forms were used for complementary clues to our observations. The analyses are presented in table 1.

**Table 1: Aspects of Teaching and Students' Work and Result
Regarding Uses of Techniques and Utensils During Three
Research Lessons**

Research lesson Aspect	Test lesson 1	Test lesson 2	Research lesson
Type of instruction	General instruction to the lesson	– Teacher read recipe aloud. – Questions to students about suitable utensils for each technique mentioned in the recipe	– Initial discussion about reasons for including vegetables in our diet – Teacher read recipe aloud – Questions to students before work: a) meaning of preparation techniques in recipe, b) what utensils for each technique

Research lesson Aspect	Test lesson 1	Test lesson 2	Research lesson
Tools for students	Copy of recipe as written instruction for students' self-regulated group work	Copy of recipe as written instruction for students' self-regulated group work	– Preparation before research lesson: discussion of preparation techniques in relation to utensils. – Recipe complemented with square for answers (preparations technique & utensil)
Type of group-work	Complementary, random: little or no discussion of work	– Varied between groups. – Less hesitant than in test lesson 1	Collaborative preparation: students discuss possible answers to preparation techniques & utensils
Choices of utensils	Utensils were chosen gradually. Students were focused on preparing food rather than on utensils	– Utensils were taken out as needed during the preparation process – Some groups did not follow decisions on adequate utensils	– All groups used utensils suitable for the task – Utensils chosen and ready on the workbench before preparing food
Techniques used	Several varieties in techniques used	Differences between and within groups regarding correct techniques	Correct use of techniques according to recipe

Research lesson Aspect	Test lesson 1	Test lesson 2	Research lesson
Use of recipe	Variation between groups as to actual use of recipes and instructions	Students seemed to understand what they were expected to do and used the recipe	Checked regularly
Results – quality of soup	Varying results depending on actual preparation techniques – some vegetables were undercooked. Time needed for finishing the work varied between groups	As test lesson 1	Soup was ready in a shorter time and with improved quality
Comments of relevance in students' evaluation form	Students emphasized the need of reading the recipe more carefully	Students emphasized the need of reading the recipe more carefully	Dialogue around the recipe, utensils and preparation techniques improved students' awareness of the function of utensils

Critical Aspects

Having tried out the above three types of introduction to a lesson aiming at identifying what students need to know and discern in order to choose utensils, which allow them to work more effectively and thereby improve their result on the one hand, and how teaching can be structured to make it possible for the students to develop their skills in relation to this object of learning on the other, we identified the following three critical aspects.

Firstly, a critical aspect associated with students' choice and use of utensils was their understanding of the connection between the

technical terms in the recipe and the designed functions of the different utensils. We realize that students do not always understand our explanations and that these need to be presented in a way that cannot be misinterpreted (if this is possible). Lo (2012, p. 20-21) also comments on this phenomenon:

Most teachers tend to assume that if they explain the content to their students clearly, then the students will see the content in exactly the same way as the teachers. Unfortunately, this is rarely the case. [...] If teachers wish to help students to see the object of learning in the same way as they do, they must first try to uncover students' own ways of seeing the object and the differences between their views and those of the students. They can then consider how to design their teaching to change the students' views so that they become consistent with theirs.

Through the variation, both in content and form, of the information we gave the students, as an introduction to the practical work, as well as through video-recorded observations of students work processes and their written evaluations, it became possible for us to discern which similarities and differences there were between students' conceptions of how to use utensils and our own.

Secondly, perhaps the most important critical aspect we found is the ability to identify a specific utensil and its use when reading a recipe. Thirdly, a critical aspect connected to the former one is that students need time to interpret the recipe. In a way, the recipe could be seen as a relatively simple form of written instruction. But because students seemed to have little experience of reading recipes, the recipe reading and understanding was insufficient in several cases during the first two test lessons. Having understood this, we concluded that the connection between the techniques and the utensils must be made clearer.

Concluding Remarks

One could say that the most important outcomes of this Lesson Study were on the one hand that students should learn to recognise the connection between technical terms for different tasks in food preparation and which utensils are, by design, most suitable for these tasks, and on the other how to interpret how different ingredients should be prepared (e.g. sliced, grated, diced etc.) from a recipe. For us as teachers, this means that we must give more emphasize to reading and interpreting recipes, which seems to be crucial if students are to learn to connect the utensils with the technical words in the recipe.

After having tried out different lesson designs, we agreed that the best design of the research lesson was the one that gave the greatest possibility for students learning the intended object of learning. We discovered that when the student understands what is written in the recipe and has learned to differentiate the techniques in the different stages, as well as connecting these with suitable utensils, then they also understand which utensils they need to use.

References

- Lo, M. L. (2012). *Variation theory and the improvement of teaching and learning*. Göteborg: Acta universitatis Gothoburgensis.
- Palmberger, M. & Gingrich, A. (2014). Qualitative Comparative Practices: Dimensions, Cases and Strategies. In U. Flick (Ed.), *The SAGE handbook of qualitative data analysis*, (pp. 94-108). London: SAGE Publications Ltd.
- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011*: Lgr11. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Swedish Ministry of Education (2016). *Ordinance on the Compulsory School System announced in the Code of Statutes*. SKOLFS 2016:553.
- Vetenskapsrådet (2017). *God Forskningssed* [Good research practice, in Swedish]. Stockholm: Vetenskapsrådet.

CHAPTER 7

Framing the Cases of English as a Second Language in Tanzania and Sweden

Gunilla Höjlund & Noah Mtana

English as second language or first foreign language is a compulsory subject in primary school in both countries. In Tanzania it is taught from Grade 3 and in Sweden from Grade 1 onwards.¹³ There are few examples of Lesson and Learning Studies (LLS) in foreign languages in Sweden and as far as is known none in Tanzania. Thus there was an interest in including English language in the joint research project.

The syllabi of the two countries share the view that knowledge of English increases the individual's opportunities to participate in different social and cultural contexts nationally and internationally as well as providing for wider opportunities for employment in working life. They also share the structure of the language into the elements or components of listening; speaking; reading and writing (MoEVT, 2005; Skolverket, 2011) even though the latter two are not as explicitly expressed in the Swedish syllabus compared to the Tanzanian one.

The aims or subject objectives however differ. In addition to the communicative emphasis (to enable students to express themselves appropriately in given situations) and the development of basic skills (listening, reading, speaking and writing) the Tanzanian syllabus

¹³ The Grade six students in Tanzania who took part in the study followed the 2005 curriculum and had studied English already from Grade one.

contains two additional objectives: “to acquire and apply correct English grammar” and “to acquire a sound base for higher education” which are not explicit aims in the Swedish syllabus. However, in the central content, grammar is also included in the Swedish syllabus (MoEVT, 2005; Skolverket, 2011).

Communicative language teaching permeates the Swedish syllabus texts i.e. English should essentially give students the opportunities to develop their ability to understand and interpret the content of spoken English and in different types of texts; express themselves and communicate in speech and writing; use language strategies to understand and make themselves understood; adapt language for different purposes, recipients and contexts and reflect over living conditions, social and cultural phenomena in different contexts and parts of the world where English is used.

Two situations could be mentioned that influence the learning of the English language in the two countries – the general language policy within the education system and the social and cultural context of the surrounding society. The language policy within education in Tanzania has until recently – 2014 – maintained Kiswahili as the medium of instruction in primary school and English as a compulsory subject, while in secondary school English has been the medium of instruction and Kiswahili a compulsory subject. English has also been the language of higher education (MoEVT, 2005, 2014). In the 2014 Education and Training Policy, both Kiswahili and English are stated to be the media of instruction at all levels of education in Tanzania. However, until the policy is translated into practice, it is not known how this will actually be practiced.

Swedish is and has been the language of instruction in the education system from pre-school to university in Sweden even though much of the course literature at the universities uses English language. Since the education system ‘opened-up’ to the establishing of so called independent schools some decades back an increased use of English as medium for teaching is noticeable.

The environment for using English outside school for Tanzanian primary school students is not supportive especially in poor communities. As explained in Mtana (2013), while classroom teaching of English in primary schools emphasizes grammar rules and not communication, the students who have no televisions and other materials where English is authentically used do not get the opportunity of coming into contact with the language. This might be the reason

behind why students consider English to be the most difficult and hardest subject to learn in school according to Uwezo (2010).¹⁴ The situation out-of-school for Swedish students is quite the opposite. As will be reported in the Swedish case students grow up in a very rich English environment (Sundqvist, 2009).

Aligning with the different emphases of respective curricula/subject syllabi and the respective societal context for learning the English language two rather different Lesson and Learning Studies are presented in the following: *Learning reported (direct and indirect) speech* at the Tanzanian school and *Unpacking instructions* at the Swedish school.

References

- Ministry of Education and Vocational Training (2005). *English language syllabus for primary schools Standard I – VII*. United Republic of Tanzania.
- Mtana, N. (2013). *Tanzanian primary school learners investing in English. What are their attitudes, expectations and opportunities?* Stockholm University [dissertation].
- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011: Lgr11*. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Sundqvist, P. (2009). *Extramural English matters: Out-of-school English and its impact on Swedish ninth graders' oral proficiency and vocabulary*. Karlstad: Karlstad University Studies.
- Uwezo (2010). *Are our children learning? Annual learning assessment report*.

¹⁴ Uwezo conducts annual large scale, citizen-led, household-based assessments that measure actual levels of children's literacy and numeracy across Kenya, Tanzania and Uganda.

Chapter 7.1

The Tanzanian English Case: Learning to Use Reported Speech

Noah Mtana & Geoffrey Murasi

Background

English language is taught as a compulsory school subject in primary and lower secondary schools in Tanzania. The language was imposed in the education system by a controversial Education and Training Policy (URT, 1995 & 2014) that has its origin in the British colonial era of 1918 to 1961 (Kimizi, 2008; Schneider, 2007). English language is learned with difficulty in the primary schools because of, among other things, inappropriate teaching methodology and a context where use in daily life outside the classroom is very limited (Mtana, 2013). When students complete primary education, they are expected to have developed enough competence in the language to use it as medium of instruction for learning all school subjects in secondary education (URT, 1995). But research (e.g. Roy-Campbell & Qorro, 1997; Mtana, 2013) shows that this is not the case. As Brock-Utne (2004) argues, rather than being the language of instruction in secondary education, English becomes the language of destruction in teaching and learning. The new Education and Training Policy (URT, 2014) seems to allow the use of Kiswahili as the medium of instruction in secondary and higher education, but also emphasises the continued use of English. It is therefore, still necessary to conduct research that would help to improve the teaching and learning

of English language in primary schools so that students can develop enough competence to use it as medium of instruction in secondary education. In addition, as expressed in Mtana (2013), English has other uses especially in this globalizing world.

The Tanzanian English Language Syllabus: What and How to Teach

It is understood from the syllabus (MOEVT, 2005) that the aim of teaching English in primary schools is to enable the students to communicate in different situations at school and outside school (e.g. at home). In Grade 6 (the class involved in the study), such communication includes understanding main points in information encountered in different situations and being able to produce simple texts about familiar topics. The majority of topics in the syllabus are organised in either language functions such as expressing duration, purpose and habits; or grammatical structures such as using relative and reflexive pronouns, and auxiliary verbs. There are also topics on reading intensively and extensively and writing guided composition. Such reading and writing would be possible if the classroom teaching of grammar (which seems to be the main focus) was contextualised enough to facilitate the development of communicative competence. It is a requirement of the syllabus that the list of provided topics is the one which “will enable the teacher to know what language functions/structures to teach” (MOEVT, 2005 p. vi). Therefore, what is taught in the English classes is basically from the syllabus topics. In terms of how to teach, the syllabus provides exemplary strategies, which demand the teacher to create relevant situations, demonstrate, and give students opportunities to practise language use.

It is known from research (e.g. Mtana, 2013), however, that classroom teaching in schools does not provide expected opportunities for meaningful learning of English. The issue of contextualisation seems to be the main obstacle as teachers are too faithful to textbooks, ignoring the immediate context in which learning takes place. Using Lesson and Learning Study (LLS) in teaching English language can act as a model for developing knowledge on how to teach language in a more effective way; hence, reduce the problems teachers face when teaching English.

A Learning Study on Reported Speech

The English case study was conducted at Mnadani Primary School, a primary school situated two kilometres from the centre of Dodoma municipality. The name of the school originates from the famous

'mnada' (Saturday flea market¹⁵) that was closed and replaced by the school in 2004. The school was built as part of Phase One of the Primary Education Development Programme (PEDP – 2002 to 2006). Surrounding activities reflect the old flea market with entertainment business including shops, pubs and bars. Families that live close to the school are mainly of small-scale business people with relatively low income. The school is disadvantaged in terms of buildings, furniture and teaching-learning facilities, which reflects the low income (also low education) of the surrounding community. The teaching staff (42 teachers) and the school head use one of the classrooms as their office while the remaining eight classrooms accommodate about 1849 students; making it necessary to conduct classes in three shifts a day (i.e. early morning, mid-morning and afternoon).

The Learning Study at Mnadani involved two researchers (Noah Mtana and Geoffrey Murasi) and three teachers (Neema Shemangare, Rehema Nkungu and Asha Ramadhani). Grade 6, which was used for the study, had about 120 students organised into three groups of 40 students each to facilitate three iterative cycles of teaching. In normal teaching, because of the problem of inadequate classrooms, there would be two groups of 80 students each.

The Learning Study project came in while the quality of education as represented by pass rate in the Primary School Leaving Examination (PSLE) was alarmingly deteriorating. In 2009, for example, 80% of the school leavers passed the examination while in 2014 only 38% of the school leavers passed. Thus, working with the teachers in this study was expected to provide an opportunity to contribute to school development by collaboratively researching on lessons and learning for improvement.

In terms of teachers of English language, the school is one of the privileged. Among the three teachers involved in the study, for example, Neema has a bachelor's degree in education (upper secondary plus 3 years of higher education), Rehema has a diploma in education (upper secondary plus 2 years of teacher education), and Asha has a Grade 'A' certificate (lower secondary plus 2 years of teacher education). Usually, the majority of primary school teachers in Tanzania during the time of conducting the study were Grade 'A' certificate holders.

¹⁵ Mnadani means 'at the flea market'. The market has now been moved further along the Dodoma – Kondoa road. It is famous for its barbeques (*nyama choma* in Kiswahili) and drinks that act as attractions for people to buy other commodities.

Choice of Topic and Object of Learning

The topic to teach was chosen after a discussion with the teachers. From the discussion it was learned that teaching reported speech was the most difficult area. Thus, topic number 5.2 in the Grade Six English language syllabus (MOEVT, 2005) for primary schools with the title ‘reporting in the past using indirect speech’ was the focus. However, from the teachers’ experience, it was pointed out that the whole area of reported speech, that is direct and indirect speech, is problematic in their teaching. The teachers find it difficult to teach and students also learn it with difficulty. Through a joint discussion between the researchers and teachers, it was decided that the object of learning should be discerned from a pre-test. The pre-test was designed around the differences between direct and indirect speech because, from the teachers’ experience and from literature, this is the most difficult part in the teaching and learning of reported speech.

Pre-test

The purpose of the pre-test was to help in determining the object of learning and discerning the critical aspects. The test had two sections namely ‘A’ and ‘B’ with a total of 14 questions. In section ‘A’ (question 1 – 8), there were pairs of sentences in direct and indirect speech as shown in the following examples 1 and 2.

1. (a) Asha said, “I am a girl”.
(b) Asha said that she is a girl.
2. (a) “My mother is a teacher”, said Halima.
(b) Halima said that her mother is a teacher.

It was decided that a small representative group of 40 students would take the test instead of the whole of Grade 6. This group had members from all three classes participating in the study. In section ‘A’, students were asked to study the pairs (above), identify the differences between them and write down those differences. In section ‘B’ (questions 9 – 14) the students were asked to change sentences from direct to reported (indirect) speech. Example questions for section ‘B’ are provided in numbers 9 and 10 below:

9. (a) My mother said to me, “cook the rice”.
(b) My mother told me to.....
10. (a) John said, “I will play football”.
(b) John said that he

The Object of Learning and Critical Aspects

The pre-test results indicated that learners were not aware of the meaning and use of reported speech. In the pre-test, when learners were asked to give differences between the pairs of sentences in direct and indirect speech, none of the learners mentioned one set as being direct and the other as indirect (reported) speech. This was interpreted to mean that the learners lacked knowledge of the concept of directly and indirectly reported speech. In line with the Learning Study tradition, this would mean that the learners have not yet learned the concept of reported speech and have not yet learned how to differentiate between direct and indirect reported speech. This was decided to become the object of learning (i.e. the students should be able to understand the concept of reported speech).

The concept of reported speech implies that there is a message to be delivered through either quoting it directly (i.e. through direct speech) or paraphrasing it (i.e. through indirect speech). Research (e.g. Mtana, 2013) shows that teaching English language in primary schools is constrained by un-contextualised instruction where teachers follow textbooks too closely and fail to use the immediate context of learners. It was decided that the teaching of direct and indirect reported speech would be more contextual than using textbooks. Therefore, in teaching the identified object of learning, a role-play was designed in which there were participants who played different roles in the delivery of a chosen message.

The critical aspects were related to two main areas namely participants in the messaging process and the forms and meaning of the message. In relation to participants, three roles were evident, namely the producer of the message, the reporter and the receivers. Producer refers to someone who originally produces the message utterance (e.g. welcome to the party). Reporter is someone who reports what the other person says (e.g. my mother has asked you to come to the party). Receivers are those people to whom the message is delivered. In relation to the message, two forms are, as mentioned, relevant namely the direct speech, in which the reporter quotes the words of the originator of the message, and indirect speech in which the message is paraphrased by the reporter. The identified critical aspects was:

- the learners had to discern the different roles assumed by each of the three sets of participants in the reporting of the message (i.e. reported speech).

- the learners had to be able to identify the differences of the message form in relation to whether such a message was in the form of direct or indirect speech.

The main difference emphasised was that, when written, the former has quotation marks while the latter has none. Thus, in the designed lesson, it was decided to elaborate during and after the role play that quotation marks (in direct speech) are used to indicate what someone actually speaks; whereas paraphrasing (indirect speech) involves reproducing what someone else said using own words. The design of the research lesson was done collaboratively between the researchers and the teachers and teaching was to be done by one of the three teachers involved in the study, namely Neema, Rehema and Asha.

The Iterative Cycles of the Learning Study

The research lessons were taught in three iterative cycles, each of which was taught to a different Grade 6 stream of about 40 students. Rehema taught the first research lesson while Asha observed. Neema was not present that day. One of the researchers (Geoffrey) videotaped the lesson. The lesson involved dramatization in Kiswahili about a mother sending her son to invite neighbours to a party. In this case, the mother was the producer of the message, the son was the reporter and the invitees were the receivers of the message. After the dramatization, the teacher discussed with the students about the meaning and characteristics of reported speech. Then, English examples of sentences in reported speech were written on the board for discussion. Emphasis in the discussion was on the characteristics of the message form in direct and indirect speech.

Lesson analysis involved the two researchers (Noah and Geoffrey), and all three teachers. In the analysis, which was made while observing the video, it was observed that through the lesson activities, the students demonstrated an understanding of participants involved in reported speech and what reported speech is. Also, they demonstrated an understanding of the main form characteristics of direct and indirect speech. However, it was observed that too much time was spent on the drama, leaving only a short time for students to practise using reported speech in English. It was decided that in the second lesson, more time should be spent on students' practice.

Neema taught the second research lesson while Rehema observed. Asha was not present that day. The teacher started by showing sentences in direct and indirect speech. Then, this was followed by dramatization

in which the teacher, through the class leader¹⁶, asked students to collect their English exercise books. Here, the teacher was the producer of the message, the class leader was the reporter, and the receivers of the message were the other students in the class. After the dramatization, the teacher discussed with the class characteristics of the direct and indirect speech. However, she did not discuss about participants in the reporting process. This means that the drama part of the lesson was not discussed. This lesson was also analysed through watching its video by all the five participants involved in the study. The analysis showed that leaving out the discussion about participants in the reporting process was a major shortfall, which might have impact on students' understanding of the meaning of direct and indirect speech. It needed to be addressed in the next iterative lesson.

Asha taught the third research lesson while Neema was the observer. Unfortunately, Rehema was not present to observe the lesson. While teaching, Asha left out the drama part and only used sentences she wrote on the chalkboard to discuss the form characteristics of direct and indirect speech. This means that, contrary to the team's plan, there was no discussion about participants in the reporting process. This shortfall might have affected students' understanding of the meaning and use of direct and reported speech. However, in this third lesson, more time was spent on students' practice. During the practice, which involved changing direct to indirect speech, it was noted that students had problems in converting direct to indirect speech, particularly in the area of changing from first to third person. If a fourth lesson was to be conducted this focus on person could be part of the object of learning.

The Issue of Iteration and Improvement of Lessons

Iteration and improvement of lessons were not in a linear relationship. Linear relationship here implies improvement of repeated lessons. One would expect that because redesigned lessons are based on analysis of previous ones, the first lesson would have more gaps, the second would have less, and the third would be the best in the series. However, this was not the case in Mnadani primary school. The first lesson seems 'better' in terms of making the identified critical aspects discernable by students than the iterative ones. From our analysis, two arguments can

¹⁶ A class usually has a student leader who acts as a middle person in communication between teachers and fellow students.

be put forward in relation to the issue: one is the partial participation of teachers and the other is the complexity of the object of learning.

First of all, the ideal situation would have been that all three teachers had been involved in the whole process of all iterative lessons. This would have allowed each of them to know how each respective lesson was conducted; the critical aspects that were taken care of; what was to be learned by students; and what improvements would make the next lesson allow for better learning. However, only two of them were present at a time in the iterative process. For example, Neema, who was not present in the first lesson, taught the second lesson and the third research lesson was taught by Asha, who was not present in the second lesson. The gaps we saw in the iterative process seem to reflect this lack of continuity. Although the video-recorded lessons were jointly discussed by all participants, and the iterative lessons were jointly planned, teaching seems to have been affected by non-presence of the respective teachers in the lessons that preceded their teaching.

Secondly, the object of learning and the critical aspects might have been too complicated to be accommodated in a single lesson. In the first lesson, the teacher could teach the concept of reported speech through dramatizing the mother's invitation to the party; and could discuss participants in the messaging process. The teacher could also give some consideration to the uses of reported speech, but could spare very little space of her lesson, as she actually did, to the forms of direct and indirect speech. In the second lesson, although the teacher supervised the drama about students collecting exercise books, she did not give space in her lesson to how the message represents reported speech. Instead, more space was given to the forms of direct and indirect speech. In the third lesson, even the drama was left out, leaving the whole lesson to focus on the forms of direct and indirect speech. We can see from this complexity of the object of learning the difficulty encountered by the teachers, hence, the failure to accommodate all intended critical aspects in their lessons. This make us think that it might have been easier if we had chosen the object of learning to be the meaning and uses of reported speech and leave the forms of direct and indirect speech to make another object of learning. This can be a lesson learned for future, more improved teaching of reported speech.

Post-test

Like the pre-test, the post-test conducted after the three lessons had two sections. Section 'A' required students to write down the differences

between four pairs of sentences in direct and indirect speech. The idea here was to assess students' understanding of the concept and form characteristics of direct and indirect speech. Section 'B' consisted of eight pairs of sentences. The first in the pairs was a full sentence in direct speech, while the second sentence was an incomplete one in indirect speech. The students were asked to complete the second sentence by filling in, among other things, the right person and verb form. Ten students (five girls and five boys) were selected randomly from each of the three streams to do the test. There was almost similar performance in all the three streams involved. In section 'A', almost all students could identify sentences in direct and indirect speech; they named them and identified the main form characteristics. But a few could not give the sentences their right identity (i.e. of direct or indirect speech). As for section 'B', all students were able to convert the sentences from direct to indirect speech, but with a few mistakes in person and verb forms in relation to time. It was evident, for example, that in changing first person (e.g. 'I' and 'we') to third person (e.g. 'he', 'she', and 'they'), the students had problems. Also in deciding on the right verb forms in relation to time (e.g. 'is' for direct to 'was' for indirect speech). It was concluded from these results that the concepts and forms of direct and indirect speech were fairly understood. It was decided that the next round of lessons should focus on the problem areas identified in the post-test (i.e. the 'person' and 'verb forms' in direct and reported speech).

Concluding Remarks

The activity has provided the opportunity for researchers from university to work with teachers of English in a disadvantaged primary school in Tanzania. Both parties learned a lot from the process. We saw, for example, the complexities involved in deciding on what to teach and how to teach a topic from the language curriculum. We learned that the framework provided by the Learning Study approach has the potential to assist in such decision making: the preliminary identification of the object of learning from the experiences of teachers and from literature, the discernment of critical aspects by pre-testing, the iterative lessons and the post-testing allow teachers and researchers to study the complexities involved in a topic and to suggest more practical ways of approaching it in the classroom. This is the main lesson learnt from the Learning Study on the teaching of English.

References

- Brock-Utne, B. (2004). English as the language of instruction or destruction – how do teachers and students in Tanzania cope? In B. Brock-Utne, Z. Desai and M. Qorro (Eds). *Researching the language of instruction in Tanzania and South Africa*. Cape Town: African Minds.
- Kimizi, M. M. (2008). Why has the language of instruction policy in Tanzania been so ambivalent over the last forty years? In M. Qorro, Z. Desai & B. Brock-Utne (Eds). *LOITASA: Reflection on phase I and entering phase II*. Dar es Salaam: E&D Vision Publishing.
- Mtana, N. (2013). *Tanzania primary school learners investing in English: What are their attitudes, expectations and opportunities?* Stockholm: US-AB.
- Schneider, E. (2007). *Postcolonial English: Varieties around the world*. New York: Cambridge University Press.
- The United Republic of Tanzania (URT) (1995). *Education and training policy*. Dar es Salaam: Ministry of Education and Culture.
- URT (2005). *English language syllabus for primary schools*. Dar es Salaam: Ministry of Education and Vocational Training.
- URT (2014). *Sera ya elimu na mafunzo*. Dar es Salaam: Wizara ya Elimu na Mafunzo ya Ufundi.

Chapter 7.2

The Swedish English Case: Unpacking Instructions – a Learning Study in English

Jessica Berggren, Pernilla Kronestedt, & Anna Palmer¹⁷

Background

Hässelbygård School is a primary and secondary school situated in one of the suburbs of Stockholm, the capital of Sweden. About 500 students attend the school and the vast majority speak Swedish as their second language; some students are born in another country and others have parents born abroad, which often means that they speak a language other than Swedish at home. Thus, the school can be described as both multicultural and multilingual. This implies that the students are used to communicating in a language, Swedish, where their vocabulary and knowledge of grammatical structures, at times, are not sufficient.

The participants in this study were 12-14 years of age and attended Grade 7 when the study was carried out. The study comprised three cycles and involved a total of 59 students. Students who had recently arrived in Sweden and had studied English for less than one year were excluded. Each cycle was conducted with a new class of students, and

¹⁷ Ms Annika Håkansson and Ms Helena Hedqvist also participated in the Learning Study as teachers at Hässelbygård School.

consisted of a pre-test, a lesson and a post-test. Whereas all students participated in the lessons, a smaller group of students, 7 in each cycle, were randomly selected for the pre- and post-tests. The study was carried out by four qualified and experienced English teachers. The teachers received support from a doctoral student in English, Jessica Berggren, with teacher background.

In general, Swedish students perform well in comparative studies and surveys of proficiency in English. For example, in the ESLC (European Survey on Language Competences) proficiency test in English, Swedish students scored top results (Skolverket, 2012). Teenagers in Sweden grow up surrounded by the English language and they are influenced by the Anglo-American culture in many aspects of society (Sundqvist, 2009). Most of them have free access to the Internet where the common language for communication is English. Moreover, TV-series and films are not dubbed to Swedish, which provides many opportunities to listen to spoken English. However, despite these favourable conditions some students tend to clam up, mumble or simply use Swedish when faced with oral tasks in English class. It seems as if they lack suitable language strategies to help them overcome communicative difficulties, such as compensating for vocabulary deficiencies. This observation served as a background to the decision regarding object of learning in this study.

As mentioned in Chapter 2 outcomes from Learning Studies can take different shapes. The Learning Study presented in this chapter describes how the process was used to pinpoint what the students needed to learn to overcome the problem, i.e. the signification of the object of learning. In addition, the study was useful in terms of developing an understanding of the students' task and challenging teachers' assumptions.

Problem and Object of Learning

There are few examples of Lesson and Learning Studies (LLS) in foreign languages in Sweden. A probable reason for this shortage is the focus on communicative language teaching (CLT) which in practice has entailed that teachers tend to work with larger communicative aims, or themes, which can be difficult to break down into lesson-sized parts. In fact, the previous syllabus for English clearly stated that teachers were not supposed to break down the subject matter into isolated pieces (Skolverket, 1994), which means that it can be discussed whether LLS are optimal choices in language teaching.

Against this background, the teacher group initially discussed possible objects of learning within the field of grammar, where it is rather easy to identify problematic areas, such as the indefinite articles *a/an*, the comparison of adjectives, subject/verb agreement, or the function of the apostrophe. Even if these areas definitely posed problems for the students, the types of mistakes they made were not likely to impede communication. Consequently, these areas were not considered important enough to focus on in a study.

Instead, the attention was turned to students' ability to use strategies. The use of strategies is highlighted in the current syllabus for English (Skolverket, 2011) and this aspect is described as both one of the abilities the students should develop through teaching, and as part of the core content. In practice, strategy use has always formed part of language teaching, but what is new is that the students' use of strategies should be graded. This novelty implies that strategies are not only described as a means to facilitate communication, they are also an explicit aim. In order to receive a high grade in English, the students need to be able to use strategies efficiently.

The preliminary object of learning was broad and partly coincided with one of the abilities that the students should develop from English instruction in Swedish school: "to [...] use language strategies to understand and make themselves understood" (Skolverket, 2011, p. 32). In relation to the students in this study, and the focus on oral proficiency, the initial object of learning was "be able to use one or several strategies to make oneself understood". This object of learning was also related to the core content, i.e. areas that need to be covered in teaching, as described in the syllabus: "Language strategies to understand and be understood when language skills are lacking, such as reformulations, questions and explanations" (Skolverket, 2011, p. 35).

As mentioned previously, some students tended to fall silent or use Swedish words when engaged with oral tasks. Possible reasons for these behaviours were discussed, and one possible factor could be lack of active vocabulary. Moreover, it seemed as if the students seldom used the communicative strategies requested in the syllabus, such as reformulations, questions, and explanations. The teachers agreed that strategies had been covered in instruction, but apparently this area could be improved. Hence, the starting point for this study and the first research lesson was a problem related to oral proficiency and attributed to lack of vocabulary and absence of communicative language strategies.

Research Design

Pre-test

In order to be able to assess to what extent the students used different strategies in oral production, a series of connected pictures were used as prompt. A fixed prompt renders it possible to anticipate possible storylines and vocabulary choices, which can facilitate the identification of communicative breakdowns and the students' use of both functional and non-functional strategies. If the students are asked to talk freely about a topic, for example something they have experienced, it is more difficult to identify strategy use, since they can leave out information or change the story to accommodate for lack of vocabulary. It was decided to use a series of pictures to encourage the students to link sentences and create a coherent story. When asked to describe a single picture, students sometimes rattle off nouns and adjectives; in addition, it is rather common that students need continuous encouragement to develop a description, which implies that the task would result in oral interaction rather than simply oral production. By using a series of pictures, the students are required to say something about each picture and also to create a coherent text with linking words, for instance. Moreover, this type of prompt makes it harder to exclude information, and a series of pictures promotes the use of verbs to create action. Last, the students in the study were familiar with this kind of task.

More specifically, a series of pictures based on a part of the film *Jaws* was used. The series depicts a diver in a cage being attacked by a great white shark, and the idea was that the students would find the story interesting. At the same time, the task could be rather challenging since it required some specific vocabulary, or possibly the use of strategies to overcome problems. The pictures and the story could potentially include words such as cage, diver, surface, and rescue team, that is words that could be considered rather advanced for students in Grade 7. Hence, this task would create the type of situation in which the students could reformulate, simplify, describe or ask questions, if necessary.

The same prompt, that is the series of pictures from *Jaws*, was used in all three cycles. However, during the course of the study the object of learning changed, which resulted in some alterations in the research design; for example, the way in which the tests were carried out. Pre- and post-tests were carried out in conjunction with each of the three

cycles, which made it possible to make changes and try new ideas. For this reason, this chapter describes the cycles chronologically so that it is possible to follow the reasoning and the decisions affecting the design.

What Guided the Design

At Hässelbygård School, all lessons are structured according to a specific lesson plan. Initially, teachers thoroughly explain the specific goal of the lesson in relation to the syllabus, and also present the different elements of the lesson so that the students are made aware of the activities and the aims. The reason for having a specific lesson plan used by all teachers is to facilitate the evaluation, development and improvement of teaching and learning. Therefore, a guiding principle for the research lessons in this study was that they were structured in a similar way, since it was believed that the students would benefit from this familiarity during the research lessons.

Due to the fact that the majority of the students at Hässelbygård School have Swedish as a second language, pictures and metaphors are often used to make sure that the students understand the aims and activities. To create a more authentic situation, it is stressed that the students imagine themselves talking to an English-speaking person when engaged with oral tasks. In other words, they should pretend that they are in an English-speaking environment where no one understands anything but the English language. This notion also underpinned the research design.

Last, the aim was to base the lesson plans on variation theory. Most of the teachers were not familiar with this theory at the beginning of the study; therefore, the process included learning about the theory in parallel with the discussions about the object of learning, analysis and the development of lesson plans.

Cycle 1

Pre-test

Due to time constraints, seven students in the class were selected randomly to take part in the test. It was carried out in class, and the informants performed the test in a separate room with a teacher who provided instructions and audio-recorded the students' oral production. The students had a copy of the series of pictures and the teacher instructed them to look at the pictures from 1-6 and tell the story and speak English. If necessary, the teacher also scaffolded the students with

questions like “what is he doing?” or “what happens next?” in order to help students who totally clammed up.

It is common to transcribe audio material for analysis, but since the audio files of the students’ performances were so short, 1-4 minutes, the teacher group decided to listen to them repeatedly instead of transcribing. This choice also meant that potential problems with interpretation and representation involved with transcription were avoided, such as transferring meaning from one medium to another. As described earlier, the teachers had a rather clear idea about potential difficulties and possible solutions, so in order to analyse the students’ oral production, a rather detailed tool for analysis was developed. It involved a rubric where the rows consisted of words, which could potentially prove difficult, for example cage and diver, and the columns described different strategies to deal with these words, such as using the word, explaining the word, and using delaying sounds. The idea was to map how the students dealt with these potentially problematic words, and determine which strategies the students used the most.

The group soon realised that this rubric was not useful. The students did not use the anticipated words and the tool, which was supposed to facilitate the analysis, became an obstacle. Instead, a more inductive approach was used; the teachers listened to each of the recordings several times in order to identify possible uses of strategies. An interesting finding at this stage was that strategies were not necessarily linked to lack of vocabulary as anticipated. This is an example of a student story from cycle 1.¹⁸

It was a man (...). He was looking for fish and shark. In the picture two a shark come. He eh (...). I don’t know. Um a shark come nearly him. And he nose come into the man and the shark hug¹⁹ him and bit. The man, the picture, eh five, the shark come up with the man from the sea. The friends (...), the friends see him and they know that he’s dead cause it was blood.

During the analysis, the teachers identified and discussed potential strategies used by this student. For example, the use of “man” in the first sentence is potentially a generalisation to replace “diver”. There were some pauses that are long enough to possibly disturb the communication, and the student also used a Swedish word. “And” was used to link different

¹⁸ Longer pauses are indicated by (...).

¹⁹ “hug” is probably a foreignization of the Swedish verb “hugga” which means “bite”.

parts of the story, but the way in which the student referred to “picture two” and “picture eh five” could disturb the flow of the story.

The potential strategies used by the students were discussed by the teachers in order to determine whether the strategies used were functional or non-functional from a communicative perspective. Functional strategies were, for example, reformulations or simplifications, but also so called Swenglish expressions, which could be understood by an English-speaking person, were considered successful strategies. Non-functional strategies on the other hand, disrupt the communication, such as long silences or mumblings.

The students’ performance in the pre-test was somewhat puzzling and challenged the teachers’ preconceptions. Even students with low general proficiency of English talked rather fluently and used simple reformulations or other functional strategies. It had been anticipated that the students would use words in Swedish or their home language to compensate for lack of vocabulary, but this was not the case. Instead, the students demonstrated a touching will to communicate in a language that few of them mastered.

Despite these findings, it was decided to continue focusing on strategies; even if the students used some functional strategies, all of them also used less successful strategies, such as mumblings and silences. It was discussed that the students perhaps preferred silence to making a mistake. Also, the teacher group agreed that the problem remained: the students’ oral production still needed to be improved. Based on the analysis, it was assumed that a critical aspect was that the students needed to be aware of the difference between functional and non-functional strategies.

Lesson

The lesson design was governed by two overarching aims: to teach the students to identify strategies and distinguish between functional and non-functional strategies, and to provide an opportunity to practice using functional strategies. The former part thus revolved around the critical aspect to distinguish between strategies and the latter part was directly related to the intended object of learning: to be able to use one or several strategies to make oneself understood. To fulfil these aims a number of lesson activities were planned.

To follow the lesson structure used in this school, the lesson started with the introduction of the word strategy and its meaning. It was illustrated using sports metaphors, and by introducing the idea of

“winning” to symbolise communicative success in languages. The rest of the lesson revolved around a similar set of pictures as used in the pre-test, but instead of *Jaws* this series was about Mr Bean, a famous character from TV and film.

The teachers had prepared two audio-recordings of other students telling the story of Mr Bean. The difference between the recordings was that one of the students used many non-functional strategies, whereas the other presented a more coherent story and mainly used functional strategies. These examples represented a variation of the critical aspect by separation, while the story, or rather the pictures, was constant. The two versions formed the basis for a discussion about strategies in terms of whether or not they impede communication. The last planned activity was that the students were prompted to practise telling the story of Mr Bean themselves. The students were also instructed to tell the story in a manner that a native English-speaker would understand. The English-speaking person was illustrated by a picture of President Obama.

During the lesson, the students showed that they were well aware of the distinction between functional and non-functional strategies, and they seemed to find it amusing to search for and identify strategies in the recordings. Unfortunately, time was running out for the last part of the lesson, in which the students were supposed to practise using strategies in oral production. This was unlucky since it became clear that the use of strategies proved difficult for the students: their theoretical or declarative knowledge did not transfer into practice or procedural knowledge. Hence, only one of the aims of the lesson was staged and the enacted object of learning changed to being able to identify and characterise strategies.

Post-test: Analysis, Results, and Reflection

The post-test was analysed and the video recording of the lesson was used to interpret the findings in light of the classroom activities and the enacted object of learning. The analysis was conducted as described in the pre-test analysis in order to be able to obtain comparable results.

Not surprisingly, the analysis of the post-test showed that the students had not improved their ability to use strategies after Lesson 1. As mentioned earlier, the students did not receive enough time to practise using strategies in production during the lesson, which of course implies that they were unlikely to develop this ability. Also, the first part of the lesson, to identify strategies, did not seem to include

new knowledge for these students. The students' post-tests sparked new discussions in the teacher group as regards the distinction between functional and non-functional strategies. For example, silence, which had been characterised as a non-functional strategy could also be interpreted as a pause to find the correct word, which would be regarded a functional strategy.

Another interesting finding was that some students seemed to skip certain words to be able to continue the narration and thus neglected to provide a coherent story based on the pictures. This finding brought to light that a critical aspect may be that the students needed to be aware that it is necessary to envisage a clear receiver of their story, even in a classroom setting. The receiver should be able to get a clear picture of the story without looking at the series of pictures. As mentioned earlier, the idea of authenticity played a vital role in the language classrooms at Hässelbygård School. Therefore, the picture of President Obama had been used to inspire the students to pretend that he was the recipient. It was clear though that the students did not catch this idea, possibly because Obama was not at all related to the task as such. Another thing that the teachers observed was that some students talked about each of the pictures, rather than telling a coherent story.

As has already been established, the enacted object of learning differed from the planned one. It is also possible that the students experienced something else, that the lived object of learning was different; it is likely that they did not comprehend that identifying and characterising strategies would help them develop their storytelling, which was the task they had to carry out. In other words, the first cycle brought more questions than answers.

Cycle 2

At this point, the use of language strategies during oral production was still the focus of the study. However, the object of object of learning was changed to emphasise the task rather than strategy use: to be able to tell a story based on a series of pictures. This modification was prompted by a discussion of the role of strategies in communication and the way they are mentioned in the syllabus, both as a means and a goal (see Background section). The new object of learning indicated that the strategies were considered a means for communication, rather than the goal.

Pre-test

The pre-test in cycle 2 was carried out in the same manner as described in cycle 1, with the exception that the teacher who provided instructions and audio-recorded the students' oral production asked the students to tell the story in English by looking at "the pictures" rather than "the pictures from 1-6". The main alteration here is that focus was removed from the pictures as separate entities of the story. During the first cycle, some students talked about each of the pictures, "in picture 3 I see", which interfered with the narration of the story as a whole. The results were very similar to the ones described in cycle 1: the students used both functional and non-functional strategies, but no one provided a really good story.

Lesson 2

The plan for the second lesson was basically the same as in the first lesson. Even if several aspects apart from strategy use had been discussed after cycle 1, such as coherence, the receiver, and the silences, none of these ideas affected the lesson plan. As mentioned earlier, the students did not receive enough time to prepare the task and practise using strategies themselves during the first lesson and there was agreement in the teacher group to give the first lesson plan a second chance. In order to make time for the students to actually practise using strategies, the first part of the lesson was made less interactive. This change entailed less time for the students to discuss strategy use; instead, the teacher more or less provided a lecture on the subject.

Post-test: Analysis, Results and Reflection

The post-test was carried out in the same manner as in the first cycle, and so was the analysis. Results were also similar; the students used both functional and non-functional strategies in the same manner as in the pre-test. Hence, the emphasis on practise during the lesson had not affected the students' storytelling.

However, the video recording from the lesson offered some insights; many students did not seem to know what to do when asked to prepare the task. Some of them just looked at the series of pictures or were engaged in something that was not related to the task during the time set aside for preparation. No one took the opportunity to look up words, jot down key words, practise pronunciation or telling the story for a friend, for example. It was obvious that the students needed to see the value of preparation in relation to oral tasks; in addition, it

once again became clear that there had to be a clearer link between the lesson activities and the oral task to tell a story based on pictures. These insights proved essential and guided the teachers through the third cycle.

During the analysis, it also became evident that using President Obama as a representative for English-speaking people, i.e. the receiver, was problematic. Several students were offended by the picture since they regarded the president and the US as enemies to their home countries. These types of ethnic-cultural differences are important to acknowledge and in other circumstances this may have given rise to interesting discussions, but for the purpose of this class it was decided that the picture be removed.

Cycle 3

The analysis of the second cycle was a breakthrough in this study. Up until now, it had been hypothesised that what caused the students to fall silent or use what can be considered non-functional strategies when speaking English, was lack of vocabulary, functional strategies and/or preparation. However, the previous lesson designs had not improved the students' ability to tell a story. Based on the findings from the first two cycles, it was now decided to change the starting point. Instead of focusing on the distinction and use of functional and non-functional strategies, the attention was now turned to preparation and understanding of the task as such.

The object of learning was still to be able to tell a story using a given series of pictures, but this time it was possible to formulate more substantiated critical aspects. Previous cycles had indicated that what caused the problems were lack of adaption for the listener, the importance of details, and a main thread. Hence, aspects that the students needed to discern were:

- that an oral task needs to be prepared;
- that an oral task has a (fictitious) recipient; and
- that an oral story needs a clear main thread.

To receive extra input before planning the third lesson and improve the understanding of these aspects, the teacher group discussed other types of task used in the classroom, and especially draw comparisons between oral and written tasks. A written task does not require the same kind of preparation, since the process of producing the text is clearly separated from the presentation of the final product. The presentation of

an oral task, on the other hand, is more immediate: the process and the presentation overlap. Also relevant for the teacher group's understanding of the object of learning, was the design and choice of the task itself. It was designed as a typical school task, and has no real counterpart in the real world. This meant that it was even more important that the students shared the teacher's understanding of the task to be able to reach a good result.

Pre-test

In order to study the students' preparation for the oral task, one of the teachers observed the students during the time they had for preparing the task. The students received the series of pictures and were advised to use dictionaries, iPads, and personal smartphones or to seek assistance from friends or their teacher if necessary. They also had access to pen and paper. The observer took notes of what the students did before they told the story for a teacher.

The students used 5-20 minutes for preparation, and most of them spent this time either looking at the pictures or looking around the classroom. Two of the students used the dictionary, and another couple of students used pen and paper. It was therefore rather clear that the idea of "preparation" in relation to the task was rather unclear to the students, and it is also possible that they did not know how to use the aids properly. In other words, the instructions regarding the task and the related activities had been unclear for the students.

Lesson 3

Following the reflections from the pre-test, the third lesson revolved around how students can prepare for the task of telling a story and why preparation is important for the quality of the narration. The teacher also covered what it means to have a listener in mind, i.e. someone who is supposed to be able to listen and understand what you are telling without looking at the series of pictures. This replaced the Obama-picture from previous lessons. In addition, the lesson included the importance of a main thread, that the story is coherent with a start, a middle and an ending. To improve the stories told, part of the lesson was also devoted to the inclusion of details and how they make a story more interesting for the listener. The critical aspects and variation patterns, which formed the basis for the third lesson, are presented in Table 1.

Table 1: Critical Aspects and Variation Patterns in Lesson 3

Critical aspect	Contrast	Constant
that an oral task needs to be prepared	story told without preparation and story told with preparation	the series of pictures (Mr Bean), i.e. the story
that an oral task has a (fictitious) recipient	story with few details and story rich in details	the series of pictures (Mr Bean), i.e. the story
that an oral story needs a clear main thread	incoherent story and coherent story	the series of pictures (Mr Bean), i.e. the story

The first part of the lesson was led by the teacher, who illustrated the aspects with examples and metaphors that the students could identify with. To connect this introduction with the task at hand, the examples dealt with the same theme as the series of pictures, that is a restaurant and food. Even if the teacher did most of the talking, the students were active by answering questions and taking part in discussions.

In the last part of the lesson, the students got the opportunity to actually practise the things covered in the first part of this lesson, that is, how to prepare an oral story-telling task. The teacher walked around the classroom and encouraged and helped the students with some useful tips for preparation when working with oral narration.

Post-test: Analysis, Results and Reflection

The post-test was carried out in the same way as the pre-test. This time, the observation showed that the students prepared the task by looking up words, checking pronunciation by using their iPads, and also asking the teacher questions. In other words, the students now used the available tools and connected “preparation” to the oral task. The analysis of the students’ narrations showed a clear improvement. A seminal difference was that the students seemed to understand the task in a better way: they actually told a story. All of them now produced rather coherent stories. Linking words were used to a higher extent, and in most cases it would be possible to follow the story even for someone who was not looking at the series of pictures. Furthermore, the stories were more detailed; for example, even the weaker students used colours and sizes to enhance their stories.

To sum up the three cycles, the main finding is that the students needed to understand what it means both to prepare and to carry out this type of oral task. The problem that initiated the study was that the students often fell silent and struggled with oral tasks in the classroom,

and the teacher group initially believed that the problem originated from poor use of strategies. Even if other factors were touched upon in the discussions, strategy use guided the design of the first two cycles in the study. The object of learning was altered already after the first cycle, but this change did not affect the design as such. It was the combined findings and insights from these two cycles that triggered what can be considered a breakthrough in this study.

Discussion

This study depicts the importance of identifying the cause of an observed problem related to teaching and learning. Initially, the focus was on strategies as a means for coping with potential linguistic deficiencies. The teacher group believed that by raising the students' awareness of strategy use and especially the distinction between functional and non-functional strategies, students' narrations would improve. This idea was also related to the syllabus for English where strategies are not only presented as a means to better communication, but also as a goal, since strategy use is supposed to be assessed. However, during the study it became evident that strategy use was not the issue. The students could distinguish between functional and non-functional strategies for example, and their performance did not improve from the lessons in the first two cycles. In the context of this study, it is probable that most of the students who participated were used to communicating daily in a second language, due to their background. Therefore, it is likely that they frequently encountered communicative problems, which could be overcome by using certain strategies. It is thus important to acknowledge students' backgrounds and challenge preconceptions to get to the root of a problem.

The cause of the problem for the students in this study was understanding the task and the instructions provided by the teacher. They were told to "tell a story" and "prepare", but these activities were neither explained nor demonstrated clearly in the first cycles. It was assumed that the students grasped these concepts, not only in general, but also in relation to the specific task at hand. For example, "tell a story" can signify various things in different contexts; in school, it is necessary to define the task in relation to the criteria used to assess the performance. Teachers and students need to develop a shared understanding of the task; it cannot be assumed that the students are familiar with the various ways in which aids such as iPads and dictionaries can be used. Also, in relation to students with other first

languages than Swedish, which was the language of instruction in the study, the problem can also be semantic. It is, for instance, important to understand that “preparation” is something that you engage with before executing the oral task. To sum up, divergent understandings of terms and activities can be related to semantics, practical experience of aids, and task perception. Especially in school contexts, where the students can be involved in high-stakes assignments, it is of course essential that teachers and students develop a shared understanding of these features.

The iterative design of the Learning Study was essential to develop the insights described above, and to challenge the teachers’ preconceptions. By analysing and discussing the students’ performances and the lessons, this group of teachers jointly developed both a better understanding of the object of learning and how classroom activities affect students’ performance. The object of learning shifted from “be able to use one or several strategies to make oneself understood” to “be able to tell a story using a given series of pictures”. Whereas the former is general and focuses on strategies, the latter is more clearly connected to the task and has clearer boundaries. Using variation theory as a guiding principle for lesson design was useful for several reasons. It helped the group of teachers looking at the object of learning from the students’ perspective and thus challenged their own understanding and preconceptions. The variation patterns also proved useful for planning the lessons; even if only two patterns were used, separation and contrast, they provided a clear framework for the lesson design together with the structure used at Hässelbygård School.

To conclude, this study has provided insights into the importance of aligning teachers’ and students’ understanding of tasks and instructions. Moreover, analysing students’ performance is essential to see problems from the students’ perspective and thus being able to design teaching favourable for their learning. It is also valuable to take the context into consideration; even if the insights obtained from this can be transferred to other schools and subjects, they are influenced by the multilingual and multicultural context of Hässelbygård School.

References

Skolverket (2012). *Internationella språkstudien 2011. Elevernas kunskaper i engelska och spanska*. [The international study of language. Students’ knowledge in English and Spanish, in Swedish] Retrieved from <http://www.skolverket.se>

- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011: Lgr11*. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Skolverket (1994). *Curriculum for the compulsory school, the pre-school class and the after school centre: Lpo 94*. Retrieved from <http://www.skolverket.se> 2018-01-14.
- Sundqvist, P. (2009). *Extramural English matters: Out-of-school English and its impact on Swedish ninth graders' oral proficiency and vocabulary*. (Doctoral dissertation). Karlstad: Karlstad University Studies.

CHAPTER 8

Framing the Cases in Mathematics in Tanzania and Sweden

Gunilla Höjlund, Inger Eriksson & Andrew Binde

Fractions are regarded as a challenging mathematical content not only in Tanzania and Sweden, but also in a broader international perspective (Kullberg, 2010). Thus, students around the world continue to struggle with fractions, even after years of instruction (Fazio & Siegler, 2011; Resnick & Singer, 1993). Even in countries where the majority of students achieve reasonably good conceptual understanding, such as Japan and China, fractions are considered a difficult topic (Fazio & Siegler, 2011). One reason for their difficulty is likely that fractions challenge students since many properties of whole numbers that they have learnt are true are not true for all numbers. For example, with fractions, multiplication does not always lead to an answer larger than the multiplicands, division does not always lead to an answer smaller than the dividend, and numbers do not have unique successors. Further, fractions (including decimal fractions) are considered to be the first serious exercises in the type of abstract mathematical reasoning that student will have to master for learning algebra, geometry and other aspects of higher mathematics (see for example Noddings, 2009). Fractions are not only an important stepping-stone for learning advanced mathematics; they are also commonly used in everyday life (Fazio & Siegler, 2011).

During the years in which the case studies were conducted fractions was addressed in Grade 6 in the Tanzanian syllabus for mathematics and constituted one out of twelve objectives, “pupils should be able to do basic operations on fractions and decimals up to two decimals” (MoEVT, 2005).²⁰ The Swedish syllabus for Mathematics in its turn includes fractions as a central content for Grade 4-6. In Sweden the everyday use of fraction is highlighted: “numbers in fractions and decimals and their use in everyday situations” and “numbers in percentage form and their relation to numbers in fraction and decimal form” (Skolverket, 2011:61).

The two countries not only share the broad content of primary school mathematics i.e. understanding and use of numbers, algebra, geometry, probability and statistics, problem solving, relationship and change but also broad objectives. Stress is put on students developing and using mathematical skills in everyday life and different subject areas. Teaching should help students to develop their ability to argue logically and apply mathematical reasoning (MoEVT, 2005; Skolverket, 2011).

The similarities of the Tanzanian and Swedish mathematics curriculum points at mathematics being a scholarly field containing a relatively well defined and integrated knowledge structure in which different knowledge domains are tightly interwoven and sequenced. Some scholars also contend that international networks are denser and expert exchanges more frequent in the field of school mathematics than for example in reading education, which could explain the commonalities (UNESCO, 2012).

When it comes to Mathematics, compared to other subjects, Lesson and Learning Studies are more commonly used as research models or models for professional development. In Sweden for example several PhD theses concern Mathematics (see Chapter 3). In Tanzania there is a PhD thesis concerning Mathematics (Msonde, 2011, see also Msonde & Msonde, 2017). Especially Kullberg reported on a Learning Study where the object of learning focused on fractions (Kullberg & Runesson, 2013). In Sweden teachers often conduct Learning Studies as a mean for professional development especially in Mathematics.

The two Learning Studies that will be presented and discussed in the following two chapters have fractions as content of their object of learning respectively. In the Tanzanian case, conducted at Makole Primary School, the object of learning relates to students’ ability to do

²⁰ In the new syllabus from 2016 fraction is dealt with in Grade 5 (MEST, 2016).

addition and subtraction of dissimilar fractions. In the Swedish case, conducted at Nya Elementar Compulsory School, the object of learning concerns students' ability to understand fractions as numbers on the number line.

References

- Fazio, L. & Siegler, R. (2011). Teaching fractions. UNESCO, International Academy of Education, *Educational Practices Series no 22*.
- Kullberg, A. (2010). *What is taught and what is learned: professional insights gained and shared by teachers of mathematics*. (Diss). Acta Universitatis Gothoburgensis. Gothenburg University.
- Kullberg, A. & Runesson, U. (2013). Learning about the numerator and denominator in teacher-designed lessons. *Mathematics Education Research Journal*, 25(4), (547-567).
- Ministry of Education and Vocational Training (2005). *Mathematics syllabus for primary schools Standard I – VII*. United Republic of Tanzania
- Ministry of Education, Science and Technology (2016). *Mathematics syllabus for basic education Standard III-VI*, United Republic of Tanzania.
- Msonde, C.E. (2011). *Enhancing teachers' competencies on learner-centred approaches through learning study in Tanzanian schools*. (Diss.). University of Hong Kong, Pokfulam, Hong Kong SAR.
- Msonde, S.E. & Msonde, C.E. (2017). What matters in student-centred learning? Managing conditions for students to appropriate the object of learning. *International Journal for Lesson and Learning Studies*, Vol. 6 Issue: 3, pp.233-248
- Noddings, N. (2009). What Can Teachers Learn from Research?. *Kappa Delta Pi Record*, 46(1), 22-25.
- Resnick, L., & Singer, J. (1993). Protoquantitative Origins of Rational Reasoning. i T. Carpenter, E. Fennema, & T. Romberg, *Rational Numbers. An Integration of Research* (ss. 107-131). US: Lawrence Erlbaum Associates
- Skolverket (2011). *Curriculum for the compulsory school, preschool class and the recreation centre 2011: Lgr11*. Retrieved from <http://www.skolverket.se> 2018-01-14.
- UNESCO (2012). Primary school curricula on reading and mathematics in developing countries. *Technical paper No. 8*. Institute of statistics.

Chapter 8.1

The Tanzanian Mathematics Case: To Subtract and Add Fractions with Dissimilar Denominators

Ayoub Sanga & Andrew L. Binde

Background of the Learning Study

The Mathematics Learning Study at Makole Primary School was initiated with the school context in mind. It seems natural to discuss the school context first before the background of the Learning Study. Makole Primary School was established in 1966 and is located within Dodoma Municipality. Students attending the school come from families of different status and background. Some of them are from well to do families that satisfy the students' educational needs, but others are from poor families that cannot even afford uniforms and exercise books. For example, eight students out of many poor students are supported by an NGO called Compassion International Organization while many struggle to meet their basic educational needs. Sometimes the situation reaches the stage that teachers feel compelled to donate uniforms, pens or exercise books. The differences in family background appear to affect their learning for feeling inferior than their fellow students.

Despite the differences in family economic background, Makole Primary School has been performing well in the national Primary School Leaving Examinations (PSLE). Students' performance in the national

examinations (Mathematics) has generally been above average in terms of grades. School records show that there is no significant difference between boys and girls in this specific case.

The numbers of students and corresponding teachers at Makole Primary School at the time of this study (2014) was respectively 1,202 students (590 girls, 612 boys) and 42 teachers (40 females, 2 males). The difference in the number of male and female teachers is glaring.

This Mathematics case provides a report of a Learning Study about teaching and learning of addition and subtraction of dissimilar fractions. Students from Grade 5 to 6 students were engaged in the study. The study adopted Learning Study as a professional development model by engaging teachers in three cycles, working on an identified object of learning. Three females and one male teacher²¹ in collaboration with one teacher educator/researcher from the University of Dodoma were involved. A lesson was designed on the basis of the object of learning and critical aspects identified. Since we are concerned with students learning of fractions as a concept, we studied the way they learn, observed their challenges and reviewed instructions to support their learning. We kept working on the critical aspects in planning for the successive lessons. We kept on introducing improved strategies, which helped to address students' challenges, and this in turn helped them to learn.

The Identification of Object of Learning

The object of learning was identified after an interview with mathematics teachers at the school. They first started by identifying difficult topics; where one of them was fractions. The team (teachers and researcher) decided to start with the object of learning: the students should be able to do addition and subtraction of dissimilar fraction. In designing and the implementation of the Learning Study, we adapted the basic principle of planning together, implementation, reflecting and the cycle was then repeated. The steps for conducting a Learning Study do not always occur in the same sequence; some steps may occur simultaneously, and some may be revisited during the iterative cycles. In practical terms, the following steps represent the general process of conducting the study at Makole primary school.

²¹ The teachers were Ms Hapiness Sam, Mr Ayoub Seif, Ms Robi Nyamhanga and Ms Ignasia Masinde.

Step 1: Identification of the Object of Learning

This involved, as mentioned, an interview and discussions with the teachers on mathematics topics they have been teaching at the time of the study and before. Support from literature reviewed justified that fractions was one of the very important topics in mathematics education at this level and yet problematic to teach and learn. Also, the researchers reviewed the curriculum of primary education, Mathematics Syllabus for Primary Education and Analysis of PSLE of 2003 and 2014 just to satisfy us. In addition, a sample of 16 exercise books was taken randomly from Standard 5, eight from each stream. This analysis revealed fractions as one of the challenging topics. Further probing during the interview revealed that addition and subtraction of dissimilar fractions was the central issue, and hence the object of learning.

Step 2: Identification of the Critical Aspects Through Pre-test

Students started by working on the pre-test, which comprised ten questions – five addition and the other five subtraction. The purpose of writing the test was to establish students' prior learning experiences, the researchers and teachers had to find out what students knew, where learning deficiencies existed and where they were most frequently developed. The pre-test was based on what had been suggested through teacher interviews, documentary review of student exercise books and study of the syllabus. Students' responses in pre-test were analysed in order to identify actual critical aspects for that group of students. In view of the pre-test analysis, critical aspects identified were 1.) Students need to discern the principle of LCM (Lowest Common Multiple) or that the students need to discern that subtractions and additions of dissimilar fractions requires similar denominators. 2.) Students need to discern other options of discerning addition and subtractions of dissimilar fractions for example the use of equivalent fractions or strip bars.

Step 3: Designing of the Research Lesson

The research lesson for first cycle was designed based on the analysis of the students' pre-test results and mathematics teachers' interviews as well as looking into their exercise books. The identified critical aspects were considered in the design. The design principles involved a high consideration of the three categories of scores (low, average, high) as revealed by the analysis of pre-test scores.

Step 4: Conducting the Research Lesson

Learning Study is basically a collaborative task among two or more teachers. In a typical Learning Study like the one at Makole Primary School, one of the four team members conducted the research lesson, the other three observed and made notes/collected data, video recorded the lesson for lesson reflection before post-test and then the next cycle (iteration).

Step 5: Administering Post-test

The post-test was given to the students after completion of the first cycle a week later. Very similar questions were used but not exactly the same. The results and responses of each question was again critically analysed in order to inform/feed into the next lesson for the purpose of improvement.

Step 6: Analysis of the Research Lesson and the Post-test

The team then analysed critically the research lesson and the post-test results and responses to determine if students were still challenged in addition and subtraction of fractions with dissimilar denominators in term of lesson design and lesson implementation. Some points of improvements were further suggested, for example: the use of more than one method in calculating the sum and difference of dissimilar fractions, guiding students to practice on multiplication and division of numbers, using visual materials showing steps in addition and subtraction of fractions further suggested by the team members. Additional interviews were held with students or probing questions were asked to see what had been learnt or their level of satisfaction in learning about addition and subtraction of fractions with different denominators.

Step 7: Redesigning of the Second Cycle Research Lesson

On the basis of studying students' learning in the previous lesson, the team re-planned the lesson for Group B. In order to sustain and improve on the previous lesson and to facilitate students' learning better, the second research lesson was designed and carried to another group of students (Group B) using similar strategies. This lesson leads to the second and later to the third cycle of research lesson.

Evaluation of Pre-test Performance

A group of 62 students sat for the pre-test on addition and subtraction of dissimilar fractions followed later by an interview. After that students

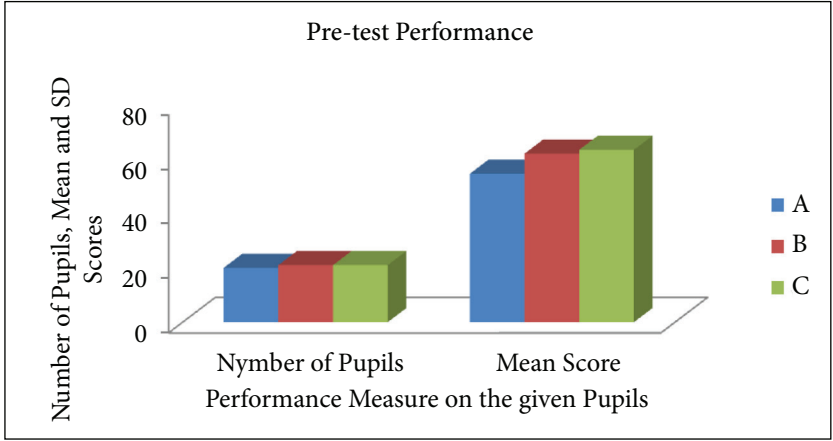
were randomly assigned into three groups. The first group (referred as Group A) comprised 20 students, the second group (referred as Group B) comprised 21 students and the third group (referred as Group C) comprised 21 students. The composition of these groups was almost uniform in term of sex and performance on the basis of pre-test. Group A comprised 11 girls and 9 boys and their average pre-test score (mean) was 54.5%. Group B comprised 11 girls and 10 boys and their average pre-test score (mean) was 61.9% and Group C comprised 11 girls and 10 boys and their average pre-test score (mean) was 63.3%. Differences in students’ performance in pre-test are shown in Table 1.

Table 1: Difference in Students’ Performance in Pre-test

Students Group	Number of Students	Mean Score
A	20	54.5
B	21	61.9
C	21	63.3

Table 1, can be displayed in the Chart in Figure 1 where all groups, A and B and C are compared to show that they are of almost equal characteristics.

Figure 1: Comparative Characteristics of the Three Groups of Students (A, B And C)



Source: Field data.

The interviews were conducted with the three categories of students who did the post-test. Higher achievers who scored 80% and above in the addition and subtraction of dissimilar fractions, middle achievers who

scored more than 50% but less than 80% and low achievers who scored less than 50%. Four students from each category were interviewed and results of the interviews revealed that: first, all students used only one method that involves LCM in finding addition and subtraction of dissimilar fraction. However, no one explained a correct reason why they used LCM in the calculations. Therefore, the result showed that they just memorised steps without knowing exactly why they did so.

Secondly, it was also revealed that even some higher achievers failed to simplify the final answer due to problems of division and multiplication or they just neglected to do so. Apart from the challenges, higher achievers as well as students in the middle and low achievers' category faced problems on finding LCM and involving it in addition or subtraction of fractions. Lower achievers had additional problems or misconceptions. Some didn't know exactly the procedure and they treated denominators and numerators as two different numbers. For example, one student performed the following calculation in this way: $\frac{1}{2} + \frac{1}{3} = \frac{2}{5}$. This means that the student added the upper numbers as well as the lower numbers as if they are separate numbers and not as components of fractions or parts of whole.

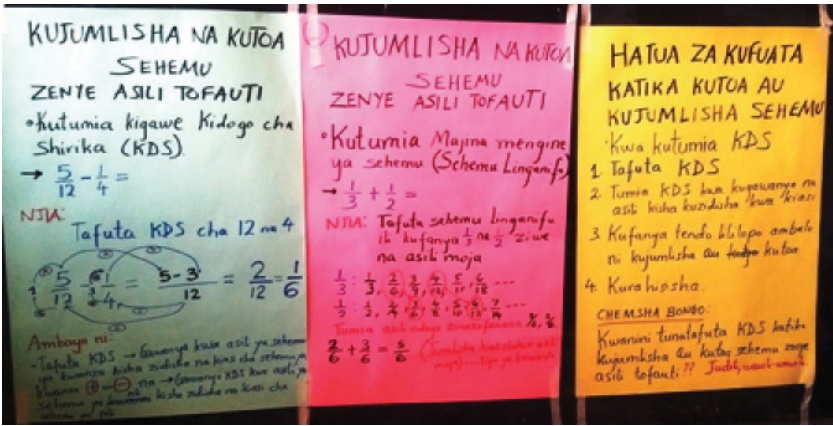
Evaluation of Learning Study Cycle One

In light of the pre-test observations, interview with students and teachers in a team, the lesson for Learning Study cycle one was planned. The lesson was planned in collaboration with the team of mathematics teachers engaged in this study. In the plan for the lesson the team considered critical aspects and interview responses to design methods and strategies that will effectively address students' weaknesses. The team decided to work with group A of students in the Learning Study cycle one.

Apart from other designs, the team designed visual material in a poster to illustrate step-by-step procedures in addition and subtraction of fractions by using LCM. Also, another (see Figure 2) used to display procedures in finding the LCM of a given set of numbers. One girl and one boy were called at different times to work out the solution for two different questions in front of the class.

After the first cycle lesson, students completed a post-test in the following week. The lesson was video recorded for review and the results were used to see the level of understanding of learners about different critical aspects that were considered in the lesson.

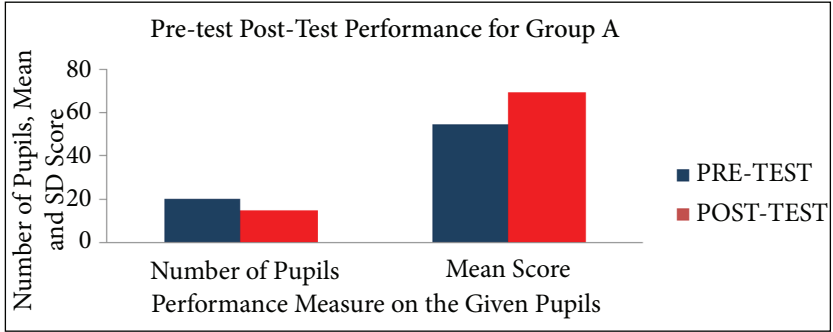
Figure 2: The Three Posters which are in Kiswahili (National Language)



Is about: The left hand side poster indicates addition/subtraction of dissimilar fraction using LCM; The middle poster is about addition/subtraction of dissimilar fractions using equivalent fractions and the right hand poster is about procedure on addition/subtraction of dissimilar fractions using LCM.

The average score of the students in the post-test was 69.3%, therefore, compared to the pre-test scores with an average of 54.2%, the students' performance was increased by an average of 15.1%. Figure 3 shows the change in performance between pre-test and post-test.

Figure 3: Comparison of Pre-Test and Post-Test Performance



source: Field data.

In this test only one student missed completely the concept of adding and subtracting dissimilar fractions. In general, students improved their level of understanding addition and subtraction of fractions of different denominators. There was some observed improvement in term of understanding the concept and fewer problems in working out questions involving fractions. Also, fewer students failed to simplify

the final answer in post-test compared to pre-test performance as shown in Figure 3.

Evaluation of Learning Study Cycle Two

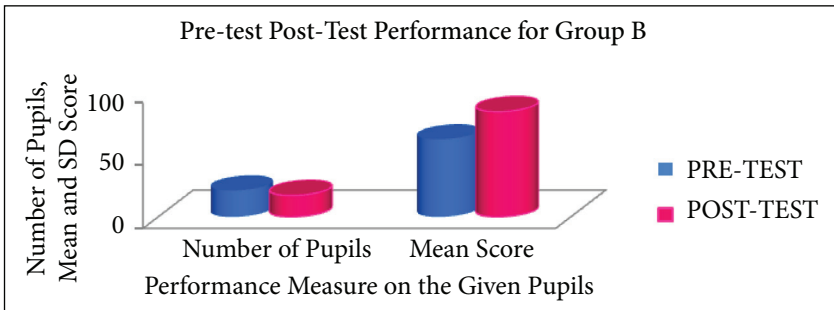
On the basis of post-test results/observations and interview responses from teachers, Lesson Learning Study cycle two was planned. Again, the lesson was planned in collaboration with mathematics teachers. In planning the lesson, the team considered critical aspects and interview responses to design methods and strategies that would address effectively students' weaknesses. The team decided to work with group B of students in the Learning Study cycle two.

Apart from other designs, the team designed a lesson by considering two strategies in working out addition and subtraction of dissimilar fractions problems. The first approach was using equivalent fractions and the second was using LCM. Visual materials in a poster (Figure 2) were used to illustrate step-by-step procedures in addition and subtraction of fractions by using both equivalent fractions and LCM. Also, another poster was used to display procedures in finding the LCM of a given set of numbers. One girl and one boy were called at different times to do two different questions before the class by using the two different approaches.

After the second cycle lesson, students completed a post-test within the first week after instruction. The lesson was video recorded for review and the results were used to see the level of understanding of learners about different critical aspects that were considered in the lesson.

The average score of the students in the post-test was 84.1%, compared to the pre-test scores of an average of 61.9% (see Table 1 above), the students' performance improved by an average of 22.2%. Figure 4 shows the change in performance of learners between pre-test and post-test.

Figure 4: Comparison of Pre-test and Post-test Performance



Source: field data.

It is possible to explain that students are used to one approach (LCM) in addition and subtraction of dissimilar fractions. One important observation from Learning Study cycle two is that students had an insight of what is behind procedures. They now know why we use equivalent fractions and LCM in addition and subtraction of fractions.

Evaluation of Learning Study Cycle Three

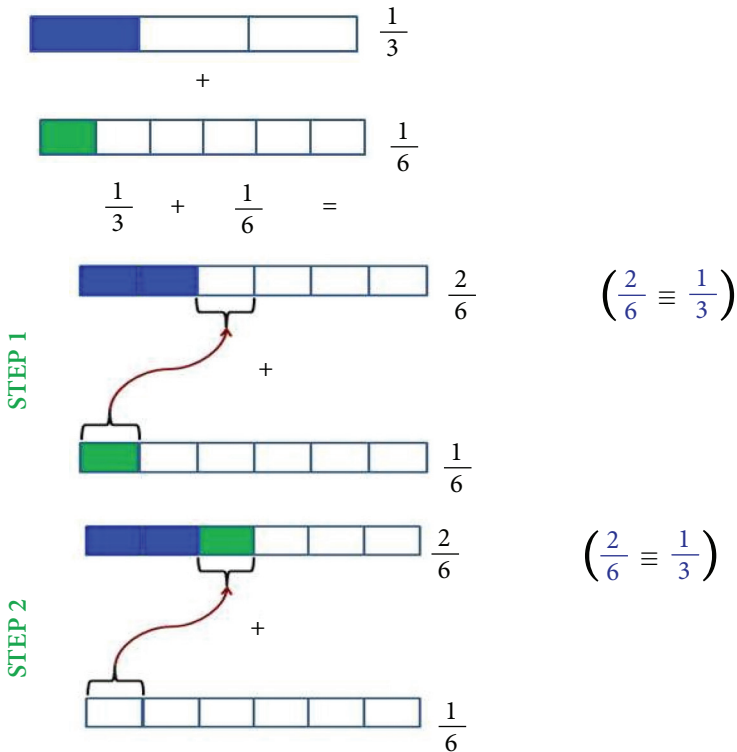
On the basis of post-test observations and interview responses from teachers in Learning Study cycle two, Learning Study cycle three was planned. Again, as in Learning Study cycles one and two, the third lesson was planned in collaboration with the mathematics teachers. During the lesson plan, the team considered critical aspects and interview responses to design methods and strategies that will address effectively students' challenges. The team decided to work with group C students in the Learning Study cycle three.

The third lesson started with an e-game – a free source from Phet²² simulations (developed by the University of Colorado) on multiplication and division. The game was conducted by one of the teachers using a computer and displaying it to the screen. Apart from designs described previously, the team designed a lesson by considering three strategies of addition and subtraction of dissimilar fractions. The first approach was using bar strips followed by equivalent fractions and lastly using LCM. The aim of using bar strips first was to create the mental image in students. This was done by using ICT where colourful bar strips and animations were used. Bar strips laid the foundation that we cannot add or subtract dissimilar fractions unless we make them similar. The idea of converting dissimilar fractions to be similar was reinforced by equivalent fractions method. Here, dissimilar fractions were made similar by equating their denominators. Visual materials in a poster (Figure 2) were used to illustrate step-by-step procedures in addition and subtraction of fractions by using both equivalent fractions and LCM. Also, another poster was used to display procedures in finding the LCM of a given set of numbers. As before, one girl and one boy were asked at different times to do two different questions in front of the class using the two different approaches.

²² This e-game is obtained from Phet simulations of the University of Colorado. It is free and open source. It is found at <https://www.phet.colorado.edu/en/simulation/arithmetic> (collected 2018-01-14).

After the third cycle lesson, students completed a post-test within the first week after instruction. The lesson was video recorded for review and the results were used to see the level of understanding of learners about different critical aspects that were considered in the lesson. Students attempted post-test questions using different methods – 10 students used LCM method, six students used bar strips method and two students used both LCM and Equivalent Denominators methods.

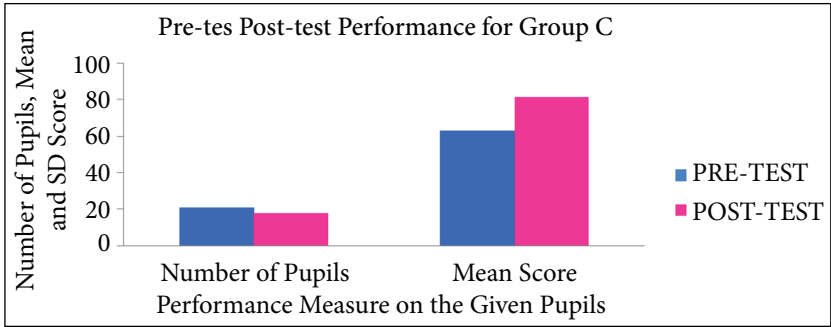
Figure 5: Slides Showing How Bar Strips were Used in Working with Fractions



The average score of the students in the post-test was 81.7%. Compared to the group C pre-test average scores of 63.3%, students' performance increased by an average of 18.4%. Figure 6 shows the change in performance of learners between pre-test and post-test.

On the basis of the post-test, students indicated that they were able to use all three strategies in adding or subtracting dissimilar fractions. Many students used LCM followed by those who used bar strips and lastly those who used equivalent fractions method.

Figure 6: Comparison of Pre-test and Post-test Performance



Source: field data.

Table 2: Difference in Pre-Test and Post-test Performance among Learners across All Groups

Test type	Observations and Improvement
Pre-Test I (Group A)	Students used LCM in addition and subtraction, some failed to involve LCM, reason for using LCM not given. A lot of misconceptions revealed, a lot of errors in addition and subtraction shown, failed to simplify and multiply. The average score was 54.5%,
Post-Test I	Used proper procedure by LCM, still didn't know why they use LCM, very little misconception (only one student), some errors in addition and subtraction observed, a few failed to simplify and multiply. Increased average performance to 69.3% (increased by 14.8%)
Pre-Test II (Group B)	Students used LCM in addition and subtraction of fractions, some failed to involve LCM, again, they didn't know why they used LCM, a lot of misconceptions observed, a lot of errors in calculation observed, failed to simplify and multiply. The average score was 61.9%.
Post-Test II	They had the knowledge of using equivalent fraction method, used LCM method properly, understood why LCM is needed, increased average performance to 84.1% (increased by 22.2%), misconceptions not observed, some errors in adding and subtracting fractions observed. A few failed to simplify and multiply
Pre-Test III (Group C)	Students used LCM in addition and subtraction of fractions, some failed to involve LCM, they didn't reveal reason for using LCM. A lot of misconceptions observed a lot of errors in adding and subtracting fractions observed, failed to simplify the final answer. The average score was 63.3%,

Test type	Observations and Improvement
Post-Test III	Used LCM, equivalent fractions and bar strips methods effectively. They revealed reasons for using any of the methods. Most students understood the concept of addition and subtraction of dissimilar fractions, increased average performance to 81.7% (increased by 18.4%), misconception not observed, some errors in addition and subtraction of fractions observed and a few failed to simplify the final answer.

Concluding Remarks

In general, the use of the Learning Study model as an approach to professional development gave the chance for teachers to reflect on their practice. The collaboration between teachers revealed advantages or issues that could not have been known if one teacher had been teaching alone. All through the process of teachers' professional development, Learning Study needs collective lesson planning, implementation and reflecting or share together among teachers. Assessment should be done for the purpose of identifying specific learning needs for students and be used to improve learning. ICT integration in teaching and learning of mathematics has been found to be useful especially when planned well with rich and interactive programs which more often than not, arouse curiosity and thinking among learners. It makes sense to say mathematics teachers in primary schools indicated the ability to use Learning Study in teaching topics, which are a challenge to both students and teachers. Once conducted it leaves teachers rich in teaching strategies and techniques that could be used in future teaching even if they will be alone without a team of Learning Study.

References

Phet simulations of Colorado University. <https://phet.colorado.edu/en/simulation/arithmetic> (collected 2018-01-14).

Chapter 8.2

The Swedish Mathematics Case: Learning to See Fractions as Numbers on the Number Line

*Sara Fransson, Kristina Fellenius, Christina Lidgren,
Per Westin & Inger Eriksson*

Background

The Nya Elementar School is a primary school situated in a prosperous area of Stockholm, the capital of Sweden. Almost 800 students attend the school and the vast majority speak Swedish as their first language.

The participating students in this study were 11-12 years of age and attended Grade 6 when the study was carried out. The study, comprised three cycles and involved in total 50 students from two streams, and was carried out by four qualified, experienced mathematics teachers. The teachers received support from Inger Eriksson (one of the project leaders). The teachers conducting this Learning Study have, for several years, worked with many different methods to develop their teaching, they had also earlier used Learning Study.

Identifying Troublesome Content

With inspiration from national exams, we tested locally constructed and standardised diagnosis material in Mathematics and, by taking advantage of the local experience, we analysed what effects teaching had on student performance. The analysis showed that the students,

among other problems, experienced difficulty in comparing the size of fractions. Furthermore, the analysis indicated that most students could easily use fractions if they were asked to divide a whole into smaller parts, for instance when they were asked to divide a pizza or an amount of money into equal parts. In the previous curriculum, before the 2011 reform, fractions have not been part of the content in lower grades mathematics teaching. The common way of teaching fractions was to show a picture representing the whole, for example a pizza, a cake or an apple. The teachers realized that the students needed to have more representations in order to be able to understand the value of fractions, for example, when arranging portions according to size (Eriksson & Eriksson, 2016).

The Object of Learning

The purpose and the object of learning of the Swedish mathematics case was initially to find out what the students needed in order to be able to arrange fractions in size order. The teachers wanted to identify which aspects students needed to discern in order to understand that a fraction has a precise value. During the work the teachers readjusted the object of learning to focus on the development of the students' ability to use fractions as numbers on the number line.

The challenge was to design a lesson that would enable the students to experience fractions as numbers on the number line. It is not enough to explain to the students how it works. This imposes demand on how exercises are constructed (Davydov, 2008; Repkin, 2003).

Research Design

In relation to the first purpose, the teachers formulated a preliminary object of learning: The ability to arrange fractions in size. With this preliminary object of learning in mind the teachers started a process to identify possible critical aspects. One key question for identification of critical aspects was "What do you need to discern in order to be able to arrange fractions in size?". Based on previous experience the following aspects were assumed to be critical for the students. The students need to discern:

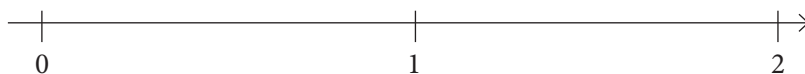
1. the relationship between numerator and denominator
2. that a fraction is a number
3. that a fraction is a specified number on the number line

These critical aspects functioned as the basis for the construction of the pre-test.

Pre-test

A written pre-test was designed aimed at scanning all the 50 students that were to be part of the study. The pre-test was constructed to test if the preliminary critical aspects were also critical for the current group of students or if they were to be changed or developed further. The pre-test contained five items each complemented with a request to give a written explanation of their reasoning when solving the task. Item 1 was to write a fraction with the denominator 5 and the numerator 2. This was constructed to evaluate if the students understood the difference between a denominator and a numerator. Item 2 was to place the fraction from Item 1 on the number line graded from 0 to 2 (Figure 1).

Figure 1: The Number Line in Item 2 in the Pre-test



Items 3 and 4 were about which of two fractions had the highest value. Item 3 had the same denominator, $\frac{3}{7}$ and $\frac{4}{7}$. Item 4 had the same numerator, $\frac{5}{8}$ and $\frac{5}{9}$. Finally, in Item 5 the students were to arrange the following fractions in size order: $\frac{5}{6}$, $\frac{4}{7}$, $\frac{11}{12}$, $\frac{3}{2}$ and $\frac{3}{8}$.

The written pre-test was complemented with interviews with seven students of the 50. The interviewees represented both students that had managed to arrange the fractions in size when the denominator in the fraction was the same and also if the numerator in the fraction was the same but they failed when they were to arrange different fractions in size. A few of students interviewed had failed to place the fraction $\frac{2}{5}$ on the number line in (Figure 1 above).

The pre-test showed that nearly all students managed Item 1. In Item 2 some of the students had difficulties in understanding that the length of the number line between 0 and 1 represented the whole. Most of the students apparently saw the whole number line represented in Item 2 as the whole, from 0 to 2. They divided the length from 0 to 2 in five equal parts. In Items 3 and 4, when the numerator or the denominator was held constant, the students had no problems in arranging the fractions according to size. In Item 5, most students managed to arrange all the fractions except $\frac{4}{7}$ and $\frac{3}{5}$. In the written commentaries most students described the fractions with the help of pictures, pizzas or rectangles – not as numbers. The post-test also showed that most of the students used functional strategies to arrange fractions by size. They were able to compare the value of fractions if they

had the same numerator or the same denominator. Some of the students could use the principles of the Lowest Common Multiple (LCM) in order to compare fractions with different denominators. Another way was to compare the fraction with a half or a whole. None of the students used the number line as a tool.

The following-up interviews confirmed that not all students were sure of what the whole was. They had no problems in seeing what a part of a whole was but they did not realise that the fraction corresponded to a value on the number line. Further, they had no problems with arranging the fractions in Item 5 by size when they could give the explanation orally. The analysis of the written test and the interviews confirmed that the preliminary critical aspects actually were critical aspects for this group of students.

Cycle One

With the confirmed critical aspects in mind, the first lesson was designed containing classroom discussions since we knew that the students were more capable of showing their skills orally. One guiding design principle was to make it possible for students to realise that a fraction has a value that can be placed on the number line. Further the aim was to help the students to understand the significance of the denominator and the numerator and that the denominator describes a whole. The teachers also wanted to challenge the students' understanding of a fraction. They wanted them to understand that a fraction is more precise than a decimal number. Thus, a situation where the students needed to answer exactly with a fraction instead of a decimal number was constructed.

The challenge to be met was how to design tasks that would enable students to experience fractions as numbers. A guiding principle was that it is not enough to explain this to the students, instead, the idea was to create a situation where it was possible for them to discover it by themselves. This, as mentioned, imposed demands on how the tasks should be designed.

In the first task during the first research lesson the students were supposed to place the number 0.285714 ... exactly on an empty number line. The intention was to create the need of a fraction and an understanding that a fraction sometimes is more precise than a decimal number. All students had an empty number line in front of them and there was also an empty number line on the whiteboard. The lesson started with a discussion of whether it is possible to put the decimal

number on the number line or if they needed to do something with the number line first. The students realized that the number line first needed to be rated. When the students thought that they had managed the task the teacher challenged them with further questions like “Is it exact?”, “Are you sure?”, “How do you know that?”.

The lesson continued with the question “What is a fraction and what is not a fraction?” The teacher put different numbers on the whiteboard: $\frac{7}{5}$, 0,3 $1\frac{1}{4}$ $\frac{1}{2}$ 15% and discussed if they were fractions or not. The students had no problem with this. Then the following questions were addressed: “What is the value of a fraction?”, “Is the fraction one number or two?” and “Can the fraction be placed on the number line?”, “At one place or more?” The discussion continued with how to place 0.285714... and $\frac{2}{7}$ on the number line on the whiteboard. Finally the students experienced that 0.285714... and $\frac{2}{7}$ were more or less the same number but that $\frac{2}{7}$ could be placed exactly.

The next task was to compare two fractions where either the numerator or the denominator was held constant. The students worked in pairs. “Which fraction is larger than the other? Motivate!”. “What is the function of the numerator and the denominator?”. The task was discussed as a whole-class discussion. The aim of this exercise was to help the students to understand the concept of numerator and denominator. After the whole-class discussion the students continued the discussion in pairs. The students reasoned about the relationship between the numerator and the denominator. “What happens when the numerator is bigger than the denominator?” “Place $\frac{5}{4}$ and $\frac{7}{3}$ on the number line.” “Are there fractions between 4 and 5?” The lesson ended with a whole-group discussion: are there any advantages to use fractions instead of decimal numbers? The students concluded that fractions were more exact than decimal numbers.

Post-test: Result, Analysis and Reflection

The post-test showed that students still had difficulties placing a fraction on an empty number line. Their difficulty lay, as in the pre-test, in determining what was the whole in order to decide the value and its place. They obviously knew how the numerator and denominator were related to each other but placing the fraction on the number line was however difficult. Considering this, the teachers decided to change the object of learning and narrow it down from “The ability to arrange fractions by size” to “The ability to place fractions on the number line”. The critical aspects were still the same since the new object of learning

was a part of the initial object. This meant that students still had to discern the same things.

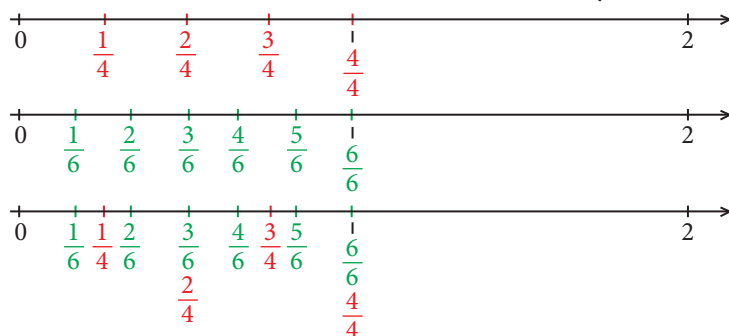
When designing the second and the third research lesson the introduction was the same as in the first lesson. The aim of the introduction was to create a need for fractions as numbers. The students worked really hard to place $0.2857142857142857\dots$ on the number line. It led to discussions and frustration. Nobody was sure that his or her result was correct and exact. This frustration escalated and they were eager to get the answer to this, in their mind easy, task. When the teacher revealed the fraction behind the decimal number they could solve the task. The tasks following the introduction were changed in order to focus more on the new object of learning.

Cycle Two

As mentioned above the second research lesson started with the same introduction as in the first research lesson. The question: “What is a fraction and what is not a fraction?” was removed because the students had proved that they had already mastered that. Instead three new tasks were designed with the number line and fractions with different denominators. Starting with fractions that the students were familiar with and continuing with fractions with different denominators.

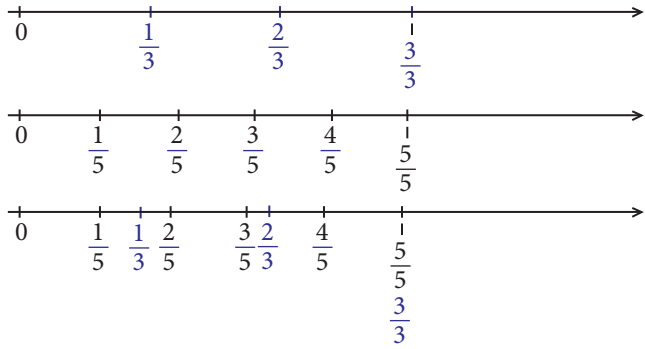
In Task 1 (see Figure 2) a number line graded from 0 to 2 was used. The idea was to help the students to realise that every fraction has a certain position on the number line. If a number line graded from 0 to 1 had been chosen, there could be a risk that the students would not realise which part of the number line they should divide into parts. This format was chosen in order to help the students reflect on the use of the entire line. After this the students had to place the different fractions on the same number line to support a visual view of the fractions.

Figure 2: In Task 1 a Number Line Graded 0-2 Used by Students



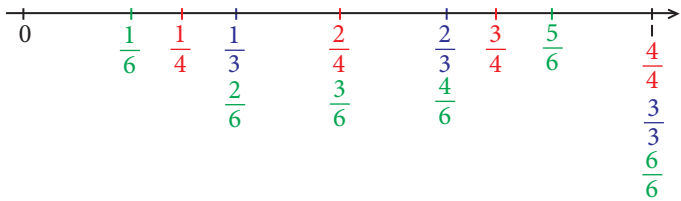
Task 2 was very like Task 1 except that the number line was graded from 0 to 1 with the number 1 marked at a length of about $\frac{2}{3}$ parts along the whole number line (see Fig. 3).

Figure 3: Students’ Solutions to Task 2



In Task 3 the number 1 was placed at the far right of the number line (see Fig. 4). The fraction the students were to place on the number line was a comparison of the earlier tasks.

Figure 4: In Task 3 the Number 1 is Placed at the Far Right



During the introduction and during the rest of the lesson the teacher showed on the whiteboard “this is the whole”. The teacher showed “the whole” with both hands from 0 to 1 on the number line.

Post-test: Result, Analysis and Reflection

Task 1, placing fractions with different denominators on the same number line gave the students opportunities to discern that all fractions exist on the same number line. It is possible that the students knew this before but they had not seen it before. With the reflection above and the fact that the three tasks in lesson 2 were very similar, it was obvious that students were not able to discern the critical aspects. Tasks 2 and 3 became more like exercises where the students measured a distance and divided it into pieces rather than experiencing fractions as numbers on the number line (see Figures 3 and 4).

Cycle Three

When designing the third research lesson, only one of the tasks with the number line was kept. In the third lesson, students' thoughts and perspectives were given greater focus. The teachers had to construct some new tasks that could force the students to think in a new way with new perspectives. So, first the students worked with the tasks by themselves and then discussed in pairs and finally held a discussion in the whole group.

As previously mentioned, the introduction was the same in research lesson three as in the two earlier. The Task 1 from lesson two was also included (see Figure 2). After this task the students were presented with the following task: "Write a fraction with a value larger than $\frac{1}{2}$ and as close to a half as possible. The numerator and denominator have to be a two digit number at the most". Initially the students worked individually and wrote down their examples. After that they compared their fractions with another student. Finally the different fractions were shown on the whiteboard followed by a discussion, led by the teacher. The following aspects were discussed:

- Are all fractions on the whiteboard larger than $\frac{1}{2}$?
- How do you know that?
- Mark the fractions that are larger than $\frac{1}{2}$. When the numerator is more than a half of the denominator we know that the fraction is larger than a half.
- Which fraction is closest to $\frac{1}{2}$?
- How do we know that?

The final exercise followed the same structure as Task 2 but focused on the fraction with a value as close as possible to $\frac{1}{2}$. The goal was to make it possible for everyone to realise that when the numerator is one and a half times larger than the denominator the fraction has the value of 1.5.

When the students discussed in pairs they were forced to put their thoughts about fractions into words. They discussed the relationship between the numerator and the denominator, which was the purpose with the task. They were arguing and tried to convince each other about what was right and what was not. During the discussion in the whole group, the students became more active and involved. This became evident when pairs randomly shared their conclusions with the rest of the class. More ideas, opinions as well as some misunderstandings occurred.

Post-test: Result, Analysis and Reflection

The post-test after lesson three gave a better result than after lessons one and two. We realized that we did not need several similar tasks in placing fractions on the number line. The combination of placing fractions with different denominators on the number line together with the discussion about the relationship between numerator and denominator, proved to be successful. This design was powerful in order to make it possible for the students to discern the critical aspects. All the students had a chance to get into the problem before they compared their thoughts with someone else and got feedback on their ideas. The discussion with the students ended in a conclusion that the value of a fraction is all about the relationship between the numerator and the denominator.

Discussion

One experience from this Learning Study is the appreciation of the importance of a well-constructed pre-test that gives you the information you need, that contains relevant critical aspects, to design the first lesson. If the pre-test doesn't give the answers to what the students need to discern, then it is difficult to create a lesson with adequate tasks. Our conclusion to this is to put more effort in constructing the pre-test than we did.

The most important conclusion drawn from this study is that students need more forms of representations of fractions than they usually meet in textbooks. They are, as mentioned, mostly used to seeing fractions as parts of, for example, cakes, pizzas or apples. Very few students have experienced fractions as a number with a value on the number line. Therefore it is vital how the lessons and tasks are designed.

Since this Learning Study was planned for three cycles we had not time to perform a fourth lesson. But if we should plan for a fourth lesson the introducing challenge of placing $0.285714285714...$ on the number line would still be used. After that without any discussion or explanation the students would be asked to place $\frac{2}{7}$ on the same number line. Hopefully they would place them very close to each other and thereby realise that these are two different representations of the same value, but the fraction $\frac{2}{7}$ is easier to place exactly on the number line. This would perhaps help students to experience the need of numbers as fractions and fractions as numbers.

Furthermore, in a fourth lesson a new critical aspect would be built into the lesson: discerning that the denominator shows the whole, for example if the denominator is 5 you need 5 parts to get a whole.

As a result of concluding discussions based upon the data from this Learning Study, an additional critical aspect may be worth considering. It was not obvious that the students realised that there is only one number line. The number line is an abstract line including all numbers. In a classroom situation teachers often use more than one representation of the number line when showing different examples. The students can be misled to think that there is one number line for every numerical range.

In order to give the students a better understanding for the number line, a final concluding remark is that it may be of importance to introduce fractions as numbers on the number line in lower grades than is the practice today.

References

- Davydov, V.V. (2008). *Problems of developmental instruction. A theoretical and experimental psychological study*. New York: Nova Science Publishers, Inc.
- Eriksson, H. & Eriksson, I. (2016). *Matematik som teoretiskt arbete – utveckling av matematiska modeller för rationella tal i åk 4* [Mathematics as theoretical work – development of models for rational numbers in school year 4, in Swedish]. *Forskning om undervisning och lärande*, 4(1).
- Repkin, V. (2003). Developmental teaching and learning activity. *Journal of Russian and East European Psychology*, 41(5), 10-33.

PART THREE

LESSON AND LEARNING STUDIES AS A TOOL FOR SCHOOL DEVELOP- MENT – LESSON LEARNT

CHAPTER 9

Two Meta-Studies of School Development in the Participating Schools

Gunilla Höjlund & Inger Eriksson

In the following two chapters a meta-study is presented of participating schools in Tanzania and Sweden respectively. The aim of the meta-studies is to contextualize the cases in relation to school development. The Tanzanian meta-study is based upon interviews with some of the participating teachers and thus focuses on school development from a teacher perspective. The Swedish meta-study on the other hand is based upon interviews with some of the Head teachers working at three of the participating schools at the time of the project. In the Swedish meta-study school development is taking the perspective of Head teachers.

The Concept of School Development – Different Emphasis in Tanzania and in Sweden

Today school development is a key concept in all countries. In Tanzania it has been observed that school development has focused on two meanings; one focusing on developing school resources, infrastructure and facilities, and the other focusing on improving outcomes or outputs of learning. This means that on the one hand, school development is economic production, building classrooms, acquiring more desks and provision of textbooks; and on the other hand it is making learners either come out with liberated and independent minds or with good passes in national examinations. Neither of these meanings has shown a

clear focus on school development as improving the process of teaching and learning, which is what the Lesson and Learning Study (LLS) project focuses on.

In Sweden resources and equipment seldom are at the foreground when school development is the topic, as they would be in Tanzania. This is of course due to differences in the socio-economical standards of the two countries. In Sweden as in Tanzania school development is often connected to students' results both in national and international measurements. At a local school level in Sweden the process of learning has attracted higher attention during the last two decades. Models such as LLS have thus also attracted attention as a means for both school development and development of teachers' professional knowledge (see Chapter 2).

Chapter 9.1

A Tanzanian Meta-Study of Participating Schools

Noah Mtana

The Concept of School Development in Tanzanian Schools

In this brief account, I present the meaning of school development from what the teachers in schools in Dodoma say about their schools. Then I compare it with my own experience and what we read in policy documents from the 1960s, when the guiding philosophy of education in Tanzania was that of Education for Self Reliance (ESR), up to now. Throughout, school development has been observed to have focused on the two meanings as presented in the introductory section above.

The Concept of School Development in the Dodoma Case Schools

When talking about school development at the beginning of the project, the head teachers of the schools involved in the Lesson and Learning Studies (LLS) referred to two main areas namely developing school infrastructure and increasing facilities on the one hand and raising academic performance on the other. When asked about how a particular school differs from others, the first reference was on infrastructure such as availability of well-equipped classrooms and desks and the

second was on numbers of students who passed the final Primary School Leaving Examinations (PSLE). The head teachers in three out of the four schools presented the issues of shortage of both classrooms and desks, and this meant that the schools were backward compared to others because they had such shortages. This, for example, resulted into overcrowded classes in the schools; and even necessitated creation of a double shift in which some classes had to use the same facilities in the morning and others in the afternoon. After a long struggle to convince the Municipal Council and parents, some classrooms were being built in Mnadani Primary School, which had the least number of such facilities. In terms of books, the Government had purchased many recently. When asked about school development projects, the head teachers mentioned existence of income generating activities such as renting land and collecting cash from people who conducted small businesses in the school compounds.

When asked about academic development, the head teachers reported about passes at Grade 7 and the number of children who could read and write. They reported rising or falling percentages of passes in Grade 7 as a measure of development. Also they reported about their struggle to increase the number of children who could read and write properly. Success in school development, therefore, was mainly measured by recording an increase in infrastructure (e.g. classrooms) and facilities (e.g. desks, books) and raising percentages of passes in final examinations.

During discussions with teachers, the same line of thinking was evident. School development was viewed as either improving facilities as measured by their quantities or improving learning outcomes as measured by skills in reading and writing and passes in national examinations. Thus, to develop the school is to have more classrooms, more desks, more teachers, more income generating activities and more books on the one hand, and to have more students passing in school leaving examinations on the other. The head teachers and the teachers would feel comfortable with their school if it had enough facilities and if a large percentage of their students would pass the national Grade 6 examinations and be selected to take up Form One places in secondary school. One can conclude that development, for these teachers, means quantitative increases in facilities and passes in examinations. Quality in the process of teaching and learning was never brought up as an issue.

School Development in Tanzanian National Context

When we study the concept of school development in a broader context, we find that its two-faceted nature is reflected nationally. We can study the meaning of the concept in two phases: one in relation to the Philosophy of Education for Self Reliance (ESR – from 1967 to 1980s) and the other after that time (i.e. from 1980s to date). In brief, although in both periods educational development (which can be narrowed down to school development) focused on both facilities and learners; in the former (i.e. during the ESR period) there was greater focus on meaningful school learning (developing inquiring minds, critical thinking and evaluation of arguments) than in the later.

School development during ESR – During the period when ESR was the guiding philosophy of education in Tanzania, school development had two meanings: one focusing on liberating the minds of learners and the other focusing on economic production of schools. In the document of ESR (Nyerere, 1967: 8) it is evident that education was expected to change learners from dependent individuals to self-reliant ones. This meant people who were:

...able to think for themselves, to make judgements on all issues affecting them; they have to be able to interpret the decisions made through the democratic institutions of our society, and to interpret them in the light of the peculiar local circumstances where they happen to live.

In this sense, school development would be assessed in terms of how it achieved the goal of developing people who can think independently and make rational judgements. This is different from merely passing examinations. It means also creating a high quality learning environment that would produce such people after the school learning cycle.

On the contrary, however, the ESR philosophy was often interpreted differently by schools. It was sometimes interpreted into time-tabled income generating activities that were done after classroom time. So, when one went to a school and asked how ESR was implemented, one was shown these activities both in the school time-table and in their actual implementation and how they contributed to the school income. The income generated from these activities was named ESR fund. These activities were a major part of school development, and school inspectors monitored them and the income generated from them. Successful schools were usually thought to be those that generated more income, which could be used to complement what the Government provided for running the schools. During this period, and maybe after,

school development projects meant income generating activities. A 'self-reliance fund', which was raised through the 'self-reliance' activities, still exists in many schools today including the College of Education of the University of Dodoma. Thus, school development meant either developing the learner to be self-reliant or doing economic production activities to raise the school fund.

School development after ESR – After the period when education for self-reliance was of emphasis (i.e. from 1980s), school development still has two meanings but slightly different from the previous. When we read documents (e.g. Ministry of Education and Vocational Training, 2013) and listen to people talking about school development, we get on the one hand, the focus on developing infrastructure and facilities to allow larger numbers of enrolled students; and on the other hand, increasing passes in examinations. School infrastructure has become a major concern because of the decisions (since the 1970s but also re-emphasised in 2002 and 2016) to increase opportunities for schooling, which has resulted in a massive increase in school enrolment. To create enough school space, there is a lot of emphasis on building classrooms. But, in order to keep an eye on 'quality', there is also concern about teacher to student ratios, class sizes, textbook to student ratios, toilet to student ratios and the number of desks available in a school. Regarding students' learning, what counts much more are their passes in national examinations. For primary schools, we hear about performance in the Grade 4 and end of primary school examinations as the measurement of school development. Schools with more students passing these examinations are said to be more developed than those with fewer passes. In secondary education, the focus is on the Form II, Form IV and Form VI examinations. Schools with more students passing are the ones seen as more developed. Thus, schools compete to have more passes and use this as their measurement of success, as they are often nationally ranked in terms of the pass rates of their students in these examinations.

School Development and Lesson and Learning Studies

It is generally acknowledged that availability of good infrastructure and enough learning facilities can contribute to effective teaching and learning and result into high pass rates in examinations. But narrowly focusing school development on either or even both of these meanings can produce poor outcomes of schooling and encourage practices that

favour 'skills of passing' rather than those of learning. Currently, for example, there are complaints from secondary schools, of students who pass the PSLE and who enter the secondary schools with very low ability to read and write, though they may have 'passed' reading and writing parts of the PSLE. The results of a study by Uwezo (2010) were shocking because it was revealed that children even at Grade VII had very low reading ability. At university, where the author of this section works, there are similar complaints that, for example, many students have a low reading ability, poor oral presentation and writing skills. Even in the master's degree programmes, we get some students who have relatively poor reading and writing skills, but who attained acceptable passes in their school examinations. This is enough to alert to the fact that a system that prioritises availability of facilities and large numbers of passes in examinations as a measure of good performance does not comprehensively measure the degree to which a school is well developed. Thus, we need to re-think the meaning of school development. The current effort of working with teachers in studying learning (i.e. through LLS) can help to change the focus from quantity of facilities and passes in examinations to improving the quality of teaching and interaction with learners in order to provide opportunities for meaningful learning that would result to having self-reliant citizens.

Selection of Dodoma Case Schools

The four schools involved in the LLS project were purposefully selected from Dodoma municipality. It was decided by the researchers prior to the selection that, in order to spread the benefits of such a project, each subject case (i.e. Mathematics, Science, English and Vocational Skills) should be in a separate school. It needs to be noted here that joint research projects among universities and schools are rare in Tanzania and that the LLS was among the first of such projects in Dodoma. Another point to be noted is that primary schools in Dodoma do not have websites to display their profiles and other information. Thus, selection of the schools would need carefully determined criteria so that, on the one hand, the research project would be successful and, on the other, the schools involved would benefit as much as possible from the project.

Criteria for the selection were determined after considering previous experience from research, negotiating with municipal education administrators, and making actual visits to the schools. From previous research (e.g. the local school development study conducted by the University of Dodoma and the Stockholm University in three schools

in Dodoma municipality), it was evident that for joint research between schools and university staff to be successful, school administrators and teachers should be willing to participate. This means that they should have positive attitudes towards such research and towards using the research process and findings to bring positive change. Negative attitudes of the host participants (e.g. school teachers, and administrators) are likely to result into resistance, which might jeopardise the achievement of project goals. Because of this, it was decided that the selection would involve negotiating with the Municipal Education Officer (MEO) to establish a list of possible schools, visiting all listed schools to introduce the intended project to their heads and staff in order to get their consent. During the negotiation among the researchers and between the researchers and the MEO, some more criteria for choosing the schools were developed. For example, it was decided that because of the complexity of the LLS model, selected schools would benefit if teachers of the respective subjects (i.e. focus subjects for each cases) and their respective school heads had university degrees. Also, schools to be selected were determined by looking at the class size of Grade VI, which would be the research class. In order to facilitate for iterative cycles, it was decided that the research class should have three streams. Finally, it was decided from experience that schools that were disadvantaged in terms of socioeconomic environments and which did not perform very well in the PSLE be given priority. This was because such schools were most in need in respect of improving teaching and learning. The negotiation between the researchers and the MEO's office resulted into a list of eight schools, all of which were visited and from which data were collected for decision-making.

During the school visits, school heads were informed about the intentions of carrying out the joint research project and were interviewed to get, among other things, the profiles of their schools and their willingness to participate in the study. Where possible, the introduction to the project and data collection about the schools involved assistant heads and teachers who were available at the time. The information collected from the visits was analysed and used to select four schools as follows: Mnadani (for English), Kaloleni (for Science), Makole (for Mathematics), and Makulu (for Vocational Skills). The qualifications of school heads and respective subject teachers were as follows: At Mnadani, the school head and one English teacher were university graduates while one other of the English teachers had a diploma in education (i.e. upper secondary school and two years of teacher training). At Kaloleni, the

school head, which was also a science teacher, had a university degree. At Makole, the school head and one Mathematics teacher were university graduates; while at Makulu, the school head and three other teachers were university graduates. None of the Vocational Skills teachers had a university degree.

Achievements and Challenges in the Dodoma Cases

Towards the end of the project, teachers from each school were asked to talk about and write their views about their study. When these teachers' views were analysed, it was found that there were several benefits and a few challenges expressed. The benefits are on teacher involvement and their professional development, and on students' participation and interest. In terms of challenges, they were mainly around large classes, time management and the complexities emanating from team teaching. These achievements and challenges are elaborated below.

Achievements

Teacher involvement – As explained in the individual cases, the teachers were actively involved in the activities of the project. From the beginning, they worked with university researchers in identifying the objects of learning, preparing and administering pre-tests, discerning the critical aspects and planning the initial study lessons. During implementation of the planned lessons, while one of the teachers taught, the other team members observed and kept record of what was happening. In addition to their notes, the teachers observed the recorded lessons together, post-tested the students and used the obtained data to make decisions on areas to improve in the iterative lessons that followed.

As acknowledged in their accounts, this involvement changed the teachers' ways of working. They are more collaborative, have a new perspective on their students' learning needs and are more eager to involve other teachers. One of their suggestions was to continue using the approach of teaching for the betterment of their schools. Another suggestion was to conduct seminars and invite the other teachers to learn from them so that their schools would use the approach. One of the teachers said, "our working approach has made other teachers work together. They even ask others for help when it is needed. This was not happening in the past". From the teachers' accounts, it can be concluded that the teachers' involvement in the project has to some extent positively influenced the working culture of their schools.

Teacher professional development – As literature shows (Elliott, 2009; Cheng & Lo, 2012; and Msonde, 2011), teachers' professional development has been one of the main goals of LLS. In their spoken and written accounts, the teachers involved in the project acknowledge developing professionally in several different ways. This development has made them improve their teaching by working collaboratively, focusing on appropriate object of learnings and considering learners' needs when planning their lessons, selecting appropriate teaching materials and methods, and preparing relevant assessment tools and procedures. This development made the teachers more confident in their teaching; as one of them said: "the project has made me able to easily teach the topic I considered difficult". Other testimonies from the teachers are:

I have learned more about how to identify my students' learning needs.

I have understood and identified problems that students face during learning.

I have improved my selection of teaching aids and techniques such as role-play

I can now teach practically and make my students have deep understanding of what they learn.

I can now prepare more relevant assessment tasks for my students.

Thus, it can be concluded here that, the LLS project has developed the teachers' knowledge and skills and has made them more confident in their teaching. This can be summed up by a quote from one of the teachers who said, "I have increased my understanding on how to prepare a lesson, to teach and how to prepare assessment tasks".

Students' increased participation – Teaching during the project was more activity based and students worked collaboratively. Teachers encouraged them to participate in the activities, which involved talking, doing practical work, reading and writing. Many of these activities were done in small groups where everyone was required to participate. From this, one of the teachers reported that the students "...showed a daring attitude of self-expression and answering questions".

This could be a result of teachers' improved teaching skills and the positive attitudes of the teachers towards students' learning. One of the teachers testified by saying, "I have learned that it is not good to begin by harassing the student because it removes his/her readiness for learning." What the teacher is saying implies that, previously, the teachers were treating students harshly and this discouraged the students from actively participating in the activities of learning.

Appeal to students' interests – The teachers explained that because of the teaching approach used during the project, their students have been motivated to learn the topics they perceived before as difficult. The students were motivated to learn through activities in groups. Moreover, the teachers declared their students to have improved in critical thinking. One of the teachers said, as a result of the teaching approach, “the students are happy being in the class learning”. Another teacher said, “as a result, attendance in lessons has improved”.

Challenges

Three main challenges can be noted here. These are time constraints, teaching and learning materials and large classes. First of all, the teachers involved in the study noted that despite the benefits they gained, working with LLS is time consuming. It is acknowledged that planning lessons together, teaching and observing together, going through the recorder lessons, conducting pre- and post-tests and conducting iterative lessons needs more time than is usually the case when they teach in their normal way. This issue of time is compounded by the fact that several teachers worked together and this interfered with the normal school timetable. As one teacher from Kaloleni said, there was “interference of lessons with the school timetable for the teachers involved in the study”.

Secondly, the research lessons required teaching and learning materials that were not used in other lessons. At Makulu, the lesson on bread baking needed materials and equipment that the school was not able to provide. The same thing at Kaloleni as one of the teachers said,

Although some teaching and learning resources were improvised, some materials had to be bought. This requires using extra financial resources, while in the schools it is not common to provide funds for buying the teaching and learning materials. The problem broadens when the class size is large.

Another challenge is that the issue of large classes still exists. One of the teachers said, “Mnadani School has very many students while classrooms are few. There are 1849 students and 8 classrooms. This makes it difficult for teachers to carefully monitor the learning of children, marking their exercises becomes difficult.” The same problem was reported at Makulu where one of the teachers said, “there are too many students in classes while facilities are few”. Even at Kaloleni where classes are relatively small, there are complaints that, “it is difficult to study students’ learning in such a large class of about 35 to 40 students”.

This means that a study like this would work better with smaller classes. But all in all, the teachers agree that the study had more benefits than losses. The research team feels it has been able to show that LLS can change the attitudes of teachers towards school development at the level of the research schools. It is hoped that, the approach can make a bigger difference if practiced at a wider area such as ward or district level.

References

- Cheng, E.C.K. & Lo, M.L. (2012). *The approach of Learning Study: Its origin and implications*. Hong Kong: Hong Kong Institute of Education.
- Elliott, John (2009). *Lesson and Learning Study: A globalizing form of teacher research*. A paper presented at the Annual Conference of the British Educational Research Association, University of Manchester, UK.
- Ministry of Education and Culture (1995). *Education and Training Policy*. Dar es Salaam.
- Ministry of Education and Vocational Training (2013). *School Improvement Toolkit: A practical Guide for Head Teachers and School Heads*. Dar es Salaam.
- Ministry of Education and Vocational Training (2014). *Education and Training Policy*. Dar es Salaam.
- Msonde, C.F. (2011). *How 'learning study' enhances teacher learning to implement learner-centred instruction in secondary schools*. A paper presented at the Four Community of Practice for Learner-Centred Education, Dar-es-Salaam, December 2011.
- Nyerere, Julius K (1967). *Education for Self Reliance*. Government Press, Dar es Salaam.
- Uwezo (2010). *Are our children learning?* TEN/MET, Dar es Salaam.

Chapter 9.2

A Swedish Meta-Study of Participating Schools

Åsa Hirsh

Introduction

The project concerned school development through teacher research, and involved a comparative study on Lesson and Learning Studies (LLS) in Sweden and Tanzania. Four LLS cases in each country were carried out, as described in previous chapters of the book.

In order to contextualize the cases and enable further problematizing of how LLS may serve as a tool for school development, one meta-study in each country has been carried out. The following chapter presents the Swedish meta-study, and concerns prerequisites and barriers for LLS to be a tool for school development. The aim is to explore – from a principal's perspective – how school development can be understood, how opportunities, success factors and obstacles in relation to school development can be perceived, and on basis of this discuss LLS can function as a tool for school development in the Swedish context.

The Concept of School Development and the Role of the Principal

School development is described in Swedish policy documents as an on-going local process aiming at developing each student as far as possible in relation to the goals of the national curriculum (The Swedish National Agency for Education, SNAE, 2015). These goals are

on the one hand about acquiring and developing knowledge, and on the other hand about developing values (Sverige, 2017 [The Educational Act 2010:800]). Basically, this means that the concept of school development may be understood as having a bearing on every aspect of the work of schools.

The Educational Act requires schools and facilitators to follow up school development continuously and systematically, meaning that principals and schools need to analyse their results in relation to national goals. According to policy documents (SNAE, 2015) this means that all work should have a structured and sustained focus on long term development, and it is the responsibility of each principal/school to identify development areas for increased goal attainment in relation to national goals, as well as to find forms and routines for quality work and the evaluation of such work. Thus, based on policy formulations it can be concluded that a school principal is a key person in relation to school development efforts, which is one of the reasons behind carrying out the study that the current chapter describes.

Our project as such is about teacher-driven school development, but all school development in Sweden is not teacher-driven. The principal of a school has overall and ultimate responsibility for the school in terms of learning outcomes and well being of students. Moreover, s/he also has the task of being the educational leader of the teachers at the school. It may therefore very well be that school development is determined and initiated by the principal. School development work/projects may also be decided at the facilitator level (usually a municipality, but sometimes a private operator) or even initiated at the national level.

Whether school development work is teacher-initiated/teacher-driven or not, principals must be considered to play an important role, for instance in providing frames for teachers to carry out their work. The results and legitimacy of the teachers' school development work may also be dependent upon the principals' knowledge, attitude and support.

Method

Four Swedish primary schools were involved in the four different case studies. The schools are situated in varying areas: inner city, suburbs and one rural area. The student base is varied with respect to ethnicity and socio-economic circumstances. Such circumstances will be described for each school respectively in the results, since they are likely

to impact various school improvement work/projects that are taken on at a specific school.

In order to get a general picture of the four schools, their websites were studied in terms of how each school presents itself. Their own reports on systematic quality work were read as well. The schools' websites provide a wealth of information about each school's specific characteristics, priorities and initiatives. It is important to bear in mind, however, that in a competitive school market, such as the Swedish, it is in each school's interest to present itself in as positive terms as possible. The studies of the schools' websites and quality documents primarily served as preparation for the interviews with the principals.

A general observation based on the study of the schools' websites and quality documents, but partly also on the schools' own reports on systematic continuous quality work, was that the schools seem to engage in numerous projects of various kinds. By only studying the websites, it is hard to see a thread running through the various projects connecting them to each other. Thus, this became an important issue to try to investigate in the interviews with the principals.

At each school, interviews with principals were carried out after the Learning Study had been finished, in order to get a picture of how they perceive and understand the concept of school development in general terms, how they describe school development work at their own schools, and how they perceived the Learning Study specifically, both in terms of methodology and outcomes. One principal declined participation in the study, therefore the results that follow are based on interviews with three principals instead of four. The interviews were carried out during the fall semester of 2015, and each interview lasted for approximately one hour.

Results

The schools differ greatly from each other in terms of student base and socio-economic circumstances, and therefore face different challenges. Below, each school is described separately, consistently from the principal's perspective. The results section is followed by a comparative, summarizing analysis aimed mainly at discussing implications for LLS to function as a method for school development.

Nya Elementar School – The Learning Study in Mathematics

The school is described as a popular school where many parents want their children to attend. There are approximately 750 students (ages

6-15) and 110 staff at the school. To a great extent the students come from upper middle class families and are described as privileged in terms of having support for their studies at home. According to the principal, students almost by definition achieve good school results due to support from well-educated parents, therefore one of the main challenges is to strive for development of instruction even though academic results are already good. Both the principal himself and the facilitator believe that the school ought to show even better results than it does, considering its favourable conditions in terms of high socio-economic status. Another challenge is that parents place very high performance demands on their children, and expect that they will consistently reach high grades. If not, parents to a great extent blame the school for not supplying good enough teaching.

The school staff are described as alert, curious and young, to a high degree seeing themselves as very talented teachers. The school is popular not only among parents and students, but also seen by teachers as an attractive work place. The main challenges related to the staff group is, according to the principal, to get them to use their time in a better and more efficient way. Another challenge is the need to develop higher quality instruction, and collaborative learning where teachers share experiences and build lessons together. There is still a lot of work to be done in that area, the principal claims.

School Development at Nya Elementar School

School development is clearly defined by the principal as having to do with increasing quality in classroom instruction in order to better meet the needs of the students. It is about teachers exploring and analysing their instruction on the basis of students' learning and results, and continuously striving to improve it. Such school development requires a supportive and challenging context in terms of principals who create collaborative interfaces and ensure that there is a common thread between various targeted areas for school development. Currently, the school has several targeted areas, for instance strengthening the role of ICT in instruction, developing the school's work in special needs education at instructional as well as organisational level, developing systematic plans for screening students' reading and writing levels, and, finally, teachers' systematic development of their own instruction.

An example given by the principal of a successful school development project is a nationally initiated program to increase students' performance in Mathematics through supervised collaborative

discussions of instruction. That particular project has led to teachers making changes that are not only perceived as positive by themselves, but that are also reflected in students' actual results in Mathematics. The LLS study at the school has run parallel with the national initiative, and the results seen could possibly also be impacted by this. Concrete results of a school development project have also been seen in relation to a more systematized screening of students' reading and writing skills, where students' levels and possible difficulties have become clearer, leading to teachers having a starting point for joint analysis. In other on-going projects related to other school subjects, it is not possible to see any improvements in students' results yet. According to the principal, however, it is obvious that there is a process that is in development, for instance among a group of language teachers who are also working with LLS.

As an example of less successful projects the principal describes how the management team recently took a course in *Visible Learning*²³, which, according to him, was a total waste of money. It was poorly planned in advance, and nobody really had an idea of what changes the course might lead to.

Success Factors and Obstacles

Common to all projects that the principal describes as successful appear to be teachers exploring their own instruction and making changes in a continuously cyclic process. In order to be successful, such analyses require starting from concrete results or classroom situations, therefore video recording or collaborative observations emerge as central elements.

If things fail, the principal claims, it is often because of factors that can be related to contextual conditions framing the teachers' work, such as poor foresight and planning, lack of clarity concerning goals, or that insufficient time and/or other resources are provided. The principal sees himself as the one who is responsible for giving clear targets and providing the right conditions for development to take place. Moreover, the school management group must give concrete support through coaching and mentoring the teachers who work with school development. Feedback is described as a keyword.

²³ Visible Learning is in the Swedish context referring to John Hattie's work: Hattie, J. (2012). *Visible learning for teachers: maximizing impact on learning*. London: Routledge.

Why Learning Study?

The principal describes the decision to join the LLS project as a conscious one. “It is a way of opening the black box and show ourselves what we actually do... and when we show ourselves what we do, we can do something about it,” he says. Another important reason is the research base that LLS contributes:

It feels as though we analyse ourselves in a more objective and scientific manner with LLS... a sustainable manner... And through LLS there is also a certain language, we have a common language... there is such a clear conceptual apparatus that comes with LLS.

Asked about what results he would expect on basis of the LLS project, he replies that the method of thinking and working that teachers learn is an achievement result in itself, as is the fact that ways of thinking and working spread to other colleagues. Furthermore, he believes that one must be able to assume that students’ school performance is affected in the long term, as enhanced learning should be a logical consequence of teachers finding aspects that are problematic for students to understand in classroom instruction. He claims that the school will continue its work with LLS, and has even set out a vision: “Here at this school there should *always* be at least two on-going LLS projects”.

Admittedly, LLS costs some resources, but the principal does not think of that as problematic. An input of 100 and an output of 50 is no good, he argues, but if the input as well as output is 100, the cost in terms of time and resources must not be considered a problematic issue:

How should we go about development otherwise? Development must cost, money and time. What’s interesting to me is not how much time it takes to dig for a critical aspect, instead the interesting thing is what you get back in terms of results. And with LLS I think we do.

Hässelbygård School – The Learning Study in English as Second Language

Hässelbygård school, that hosts approximately 540 students (ages 6-15) and 120 staff, mainly face challenges related to the fact that there are so many different ethnic groups and languages at the school, and a constant arrival of new students (refugees) from other countries. The new students correspond to a certain grade level in terms of age, but their knowledge base may vary extremely. Major challenges described by the principal are second language development, and the integration of new students in ordinary classes with peers their own age. According to the principal, there is great willingness to develop among teachers: in

theory they are good at language development, but practical work has been somewhat less effective. Thus, the principal argues, it is important to bring about a non-prestigious discussion among the staff around the teaching process:

We cannot change the parents, the only thing we can influence and change at school is our own instruction. We put a lot of effort into it, but it's not easy. Despite having worked for 25 years in teams who meet to discuss regularly, many teachers still don't really talk about instruction at their meetings. Meetings still concern practical and administrative issues to a high extent.

School Development at Hässelbygård School

School development is defined by the principal as a systematic and recurrent review of instructional activities in order to get better. All current development projects at Hässelbygård concern teachers developing their ability to plan instruction that is geared more toward *all* students. Language development and collaborative learning should be seen as different sides of the same coin, he argues, and so should the school's work to develop assessment practices towards a greater breadth in methods and alignment to steering documents. The principal thus sees a common thread in all school development work carried out at his school, but he is also aware of the fact that it may not be clear to all teachers.

The conscious work with language development, in combination with focus on collaborative learning and assessment issues is described as successful and has, according to the principal, led to a rise in grade point average.

Success Factors and Obstacles

The principal believes that one should generally beware of *projects*, since the term implies a process with a beginning and an end. School development does not work that way, he argues. Factors of success are persistence and supporting teachers in understanding that changes take time and might even be painful. To implement changes that the staff do not see the purpose of, and which are not sufficiently grounded in terms of understanding among staff, is described by the principal as a waste of time:

Everyone must have the opportunity to be involved in the process before it begins. Not everyone will have it their own way, but everyone must be able to express an opinion. It's important that I'm clear about what I want... 'This is my vision, how will we get there?'. It is not good if the

principal himself figures out all the solutions, the ways to reach goals and visions... I might suggest solutions, but others must be able to argue for their opinions and solutions as well.

He sees communication, clarity and firmness as key words in bringing about successful school development: employees must feel confident in knowing where the principal stands. Moreover, he believes that all change requires monitoring and control. A principal must follow up results regularly, and dare to question those who do not contribute or do the work properly. He sees himself as a democratic leader, but stresses the fact that it is ultimately he who has the overall responsibility and the last say.

The principal argues that school development necessarily must be regarded as a local process, and it is not the task of national authorities or the facilitator to try to micromanage school development. Occasionally, however, national initiatives clash with local priorities:

We are in such a process right now, actually. It's been decided on national level that all Maths teachers are to attend a special training initiative in Mathematics. The initiative as such is of good quality... but it's quite clear that our local development processes have slowed down... since all Maths teachers attend special training instead of other meetings... It's like we have two separate groups of staff instead of one unified, where one is doing Maths and the others are doing something else.

Why Learning Study?

The principal was not working at Hässelbygård when the LLS project started, and claims he does not know for sure why they chose to join the project. He believes, however, that the teachers experienced a need for change in instruction, and an LLS project happened to be offered right at that time. It is a method that is in vogue, he argues. When an area in need of development is identified, it is common to search for a solution in terms of structures provided from other actors. The principal is ambiguous towards what he has seen so far:

The teachers themselves claim that the project has been rewarding... But what they highlight are such tiny little details... small aspects of teaching and learning... can that make a difference?

What he perceives has added the greatest value is the teachers' *awareness of the need* for a *systematic* way to scrutinize their own instruction. In that sense, the approach may be understood as extremely valuable. He claims that LLS on the one hand is narrow, in the sense that it is very concentrated to specific aspects, but on the other hand that it gives teachers insight into the fact that it is actually possible to do things.

A clear disadvantage, which is also the reason behind him not wanting to initiate further LLS projects at his school, is that he perceived that it – just like the national initiative on Mathematics – slowed down other development work at the school. The teachers in the LLS project had their focus elsewhere over a long period.

Hallsta School – the Learning Study in Science

Hallsta School is a school with approximately 300 students aged 6-15, and around 40 teachers. It is a rural school with a low grade point average, low socioeconomic status, and –when the principal first came there – with a bad reputation. According to the principal, the schools' low grade point average was not only due to students coming from socio-economically disadvantaged homes, it was largely due to them not being offered quality instruction at school. When starting to work at Hallsta, the principal saw that there were many good teachers who had not had the opportunity to develop their work for a long time, and therefore had stagnated in terms of finding proper ways to work to meet the particular needs of the student base at the school. It was obvious that there was an urgent need for change. The challenges involve, on the one hand, teachers finding other ways to see and respond to the students' particular needs, and, on the other hand, finding ways to examine their own teaching.

School Development at Hallsta School

School development work at any school must necessarily depart from the needs of that particular school, the principal claims. Further, she argues that one must look at student results, and analyse these in relation to local circumstances, in terms of student base and instructional structures. According to her, the heart of school development lies in the relation with the student. Students must feel that they are seen, heard and have influence. If not, they will lose interest and focus. If you strive to involve students in the learning process, a lot can be achieved. It is certainly also important that teachers have good knowledge of their subjects, but their attitude and response to students is as important. Key areas for development initiated by the principal, based on her analysis of the situation at the school, were about student health, transitions between school stages, and the development of methods in instruction. The issue of school stage transitions was assigned to a teacher who interviewed students and staff, analysed and wrote a report. Student health and how to respond to students in various types of difficulties

was a prioritised area involving all staff at the school, while working to change instructional methods initially was concentrated on teachers working in a couple of LLS projects.

Success Factors and Obstacles

The principal speaks of the importance of analysis and reconciliation, and argues that school in general has a tendency to rush forward. There is a lot to be done and seldom time to sit down and reflect upon what you actually do. She claims that clear positive results of school development come only when there is a clear organization around student health. Development can only be brought about when students are in the centre of attention and feel safe and confident in themselves. Once this is in place you can begin to talk about instruction and how to make it work. In order for analysis and change of instruction to be successful, time for reflection and analysis is required. The principal claims, however, that more is needed: the clarity provided by measurements before and after implemented interventions are crucial as well. It is ultimately the results that count, therefore results have to be visualised somehow.

Clarity on behalf of the principal is described as a primary success factor. Teachers need to understand the purpose of what they are expected to do and where it is intended to lead. The principal claims that teachers' opportunity to influence is another key success factor.

Teachers' influence is as important to their motivation as students' is for them, and a principal running a school is no different than a teacher running a class. Her experience is that school development is less successful when the framework is vaguely communicated, or when there are several areas to be dealt with simultaneously: "You must focus on one or two things that you want to push forward, otherwise quality will not be as good," she argues.

Why Learning Study?

When starting to work at Hallsta School, the principal felt that teachers' professional development had been neglected. Current instructional practice was not sufficiently good, and teachers had a hard time finding alternative ways to meet the students' needs. This was the main reason behind her encouraging the teachers to participate in the LLS project. The LLS project was timely and appeared as a good way to give teachers tools for analysing instruction.

The work turned out to be successful. Teachers became aware of their own instruction, but also became more reflective around assessment

issues. They started to see the students and their results in another way, where it became clear that students' achievements depend upon the opportunities provided through instruction. The principal emphasizes the importance of a framework that gives teachers the time to work together: "It's my responsibility to give them the right conditions... they need time to analyse and evaluate their instruction."

The clarity of LLS in focusing on one aspect of teaching is critical for the success of the method, the principal believes. The entire work process as such is moreover characterized by clarity: the fact that you measure student learning as an input value, then plan and teach, then evaluate, reconsider, re-plan and re-teach, and then measure again, is all very concrete:

Clearly, things happen... to teachers as well as students... Measuring before and after in LLS makes it so tangible. Immediately you see what doesn't work and then you have to reconsider. The teachers also videotaped themselves in the classroom... which gave them great insight into what they actually did and how they actually responded to the students. They began to see things in a different way.

Working with LLS, the principal claims is really about allowing analysis of aspects of instruction to take time. This is very different from how teaching otherwise tends to work in schools, where you often rush forward to squeeze everything in, and rarely make time for reflection.

Concluding Analysis and Discussion

The aim of the meta-study is to explore how school development can be understood from a principal's perspective, how opportunities, success factors and obstacles in relation to school development can be perceived, and on basis of this discuss implications for LLS to function as a tool for school development in a Swedish context.

Discontinuity as an Obstacle

According to policy documents (SNAE, 2015) all work in school should have a structured and sustained focus on long term development, and it is the responsibility of each principal/school to identify development areas for increased goal attainment in relation to curricular goals, as well as to find forms and routines for quality work and the evaluation of such work. What is meant by *long term* is not defined in time, but it is possible to assume that long term development and continuity could be hindered or disrupted by the fact that the person officially responsible for defining and leading local development processes is replaced. In Sweden today,

relatively frequent changes of principals are common (Zaccheus, 2013). Changes occur on the one hand because the principals themselves choose to apply to other municipalities or schools – partly because they experience excessive or totally contradictory working conditions – and on the other hand because facilitators for various reasons choose to reposition or “rotate” their principals (André, 2012).

It is worth noting that all four Swedish schools involved in this study have changed principals during the time that elapsed from the start of the LLS project till the end. An obstacle for LLS to become a tool for school development in a continuous and sustainable manner may thus be the relatively frequent changes of principals that are common in Swedish schools today. It is known that implementation and the achievement of sustainable change takes time, and continuity may be hampered by frequent changes in leadership.

Lack of In-depth Knowledge and Belief in the Method as Obstacles

The current study confirms that the principals view themselves as central figures for local development, and the knowledge, ideas and convictions that they bring into an organization must be considered to partly determine which school development work is made possible.

One of the principals says in the interview that he is not sure why teachers at his school chose to join the LLS project to begin with, and that he does not want to initiate further LLS studies at the school. Since he came there, he has done his analysis of necessary school development, and he believes in initiatives that involve the *whole* staff. He is clearly not convinced of the effectiveness of LLS to the degree where he would consider it a possible alternative for school development work for all teachers. In the introduction it was argued that the results and legitimacy of the teachers' school development work are dependent upon the principals' knowledge, attitude and support. An obstacle for LLS to become a tool for school development may therefore be that the principal does not believe in LLS as a method for developing instruction. This, in turn, may be due to lack of in-depth knowledge of LLS. The principal, who does not believe in LLS in the current study, is somewhat sceptical of the fact that the teachers have studied and developed – as he perceives it – such a limited aspect of a subject. It seems therefore crucial to underline the fact that the learning on behalf of teachers that takes place in the instructional analysis involved in LLS should be regarded as more far-reaching than only concerning the particular aspect studied.

A related form of collective instructional analysis, that is common in Asia, and to a certain extent also in the USA, is the *open lesson* (e.g. Miyakawa & Winslow, 2013) or *public research lesson* (e.g. Lewis, et al, 2006), where the basic idea is that a number of teachers observe a lesson in a colleague's classroom, and afterwards participate in a joint discussion session. In that session, instruction is analysed, problematized and theorized. The general description of the concept of open lesson may give the impression of a narrow focus on *one* particular aspect of a lesson in a specific subject, with specific students and under specific conditions. Miyakawa and Winslow (2013), who have done an in-depth study of two cases where open lessons have been conducted in Mathematics, however, argue that these cases were clear examples of the fact that the discussions between teachers were of a more general nature. The practical lessons and didactic methods were certainly of interest to all participants, but subsequent discussions also concerned theoretical aspects of Mathematics as such, as well as the relation to more general and overall issues of learning in other subjects. Miyakawa and Winslow emphasize that neither Lesson Study nor open lessons primarily aim to revise or refine the didactic practice in the observed lesson, but rather to develop and strengthen the didactic practice in a broader sense. They argue that the establishment of a similar “para-didactic” infrastructure, in which the common observation is the basis for subsequent discussion and collaborative learning, could enhance teachers' professional development in many western countries.

Focus on the Importance of Instructional Analysis, Clarity, and Collaborative Learning as an Opportunity

What speaks in favour of LLS as a method for school development is that all interviewed principals agree that it is the instructional processes that are central for school development. Development work, moreover, is largely described as collective and collaborative. The interviewed principals represent completely different school contexts in terms of student base, and along with differing student base come differing challenges in terms of *content*. There is, however, in many respects, a great consistency in their description of *the kinds* of changes they want to accomplish as well as the factors that facilitate or possibly hinder changes to come about. All principals describe school development as being aimed at scrutinizing instructional processes and methods with the aim of optimizing the learning situation and results for the students at each specific school, irrespective of whether students are viewed as

high or low achievers, come from favourable or non-favourable socio-economic circumstances, or whether or not problems are language related. The value of collaborative learning for the development of professional knowledge is, also in research, widely advocated (Davies & Dunhill, 2008; Gardner, et al. 2011; Hargreaves & Fullan, 2012). Hiebert, *et al.* (2002) argue that professional collaboration in groups provides teachers with social support, but more importantly, it forces participants to make their knowledge public and understood by colleagues. Thereby, it is also a starting point for joint analysis. Various types of *professional learning communities* have in recent years become a common way to organize teachers in discussion groups in order to promote collaborative learning among colleagues (Hirsh & Lindberg, 2015).

In LLS, collegial learning is certainly a central feature, and joint discussions take their point of departure in aspects of instruction in a very concrete and direct way. The principals in the present study agree upon the fact that such concretion is one of the great advantages of LLS. The more concretely one sees what needs to be developed, and the more concretely one can see the results of the changes, the better. The principals emphasize the measurement of students' knowledge through pre- and post-tests as one of the major advantages of LLS, as this gives a clear and substantial basis for teachers' discussion. Also the principal that is hesitant to endorse LLS projects emphasizes that the main benefit of the LLS project is that the method has given teachers insight into the need for systematic screening of instruction, and it has become clear to them that it is actually possible to achieve changes in instructional practices that affects students' opportunities to learn. Moreover, the other two principals argue that the conceptual apparatus in LLS is effective in providing teachers with a common language for analysing and discussing instruction. The concepts of *object of learning*, *critical aspects* and *variation* are central. Thus, the method provides tools for a type of analysis that often seems to be lacking in development of instruction. In a review of 21st century research into formative assessment (Hirsh & Lindberg, 2015), it was concluded that research as well as teachers' classroom practice to very low extent focuses on the use of assessment data for analysing and reshaping teachers' instruction. LLS, however, is doing precisely this. Assessment data, in terms of various pre- and post-tests, is used as important information in the collaborative process of plan-teach-review.

The Role of a Principal in Leading and Supporting Change

Zhang (2015) has studied strategies used by school leaders to overcome challenges and sustain Lesson Study innovations in a Hong Kong primary school. As in Sweden and many other countries, Hong Kong teachers shoulder heavy workloads in terms of number of lessons taught each week in combination with numerous non-teaching duties (cf. Cheng, 2007). There is, moreover, an examination-oriented system that to a certain extent has proved to orient teachers away from using Lesson Study strategies and towards more drilling exercises for better examination results. Another threat to the development of Lesson Study, according to Zhang (2015) is that teachers have to implement many different reforms: “It is common that a couple of innovations are forced upon the school simultaneously by the principal, the managing board, the sponsoring body or the EDB” (p. 143). The principals in the current study describe how various school development initiatives and projects are on-going at their schools simultaneously, most of which are described as being clearly linked to each other. One of the principals argues, however, that initiatives/projects where only some teachers take part may cause problems in terms of splitting the staff and thereby slowing down development processes that concern all. He claims to have experienced this both in a national initiative aimed at improving teachers’ instruction and students’ results in Mathematics, and in the LLS project at his school.

Zhang (2015, p. 144) refers to a number of scholars who have concluded that there are strategies that, to some extent, may counter possible threats and contribute to Lesson Study being sustained in schools:

First of all, shared understanding is needed among teachers and school leaders about the effectiveness of Lesson Study on student performance (Firman, 2010; Hendayana, 2010; Sarkar Arani, et al. 2010; Chichibu and Kihara, 2013). Second, teachers need working time or space to be released for conducting Lesson Study, or the prevailing Learning Study needs to be transformed into more flexible and adaptable formats to fit in different contexts of schools (Lee, 2008; Lim et al., 2011). Third, support in term of resources, manpower, guidance and incentives (from internal or external sources) should be invested in leading and maintaining Lesson Study in school practices (Ylonen and Norwich, 2013; Chen and Yang, 2013). Fourth, a non-threatening/supportive learning-oriented community of practice needs to be established to internalize Lesson Study in schools (Cheng and Ko, 2012; Lee, 2008; Perry and Lewis, 2008; Suratno, 2012; Ylonen and Norwich, 2013; Chen and Yang, 2013).

In Zhang's own case study (2015), it is concluded that the role of the principal is essential for the successful implementation of teachers' work with Lesson Study. The school studied was chosen based on two criteria: 1. Lesson or Learning Study was adopted as the main approach to enhance teaching and learning, and to promote teacher professional development, and 2. The school had, since adopting Lesson or Learning Study as its main approach to enhance teaching and learning, received remarkable development in terms of student results. Zhang concludes that the principal's role in the success of the implementation at the school included

- Guiding teachers to integrate LLS into a school vision
- Understanding teacher's needs and concerns
- Trusting teachers and cultivating a positive trusting culture
- Supporting teachers' continuous use of school-based LLS activities

All principals in the current study agree that the school development and changes they aspire to demand a context where there is a leader who clearly communicates the direction of development work, and provides feedback that is both supportive and challenging.

Communication, clarity, firmness and persistence on behalf of the principal are described as key factors for successful school development. According to the principals, the single most important factor on behalf of the teachers is the possibility to influence and have a say in development processes. This chimes with the results in Zhang's study and the factors described in the quote above.

Shared understanding among staff of the effectiveness of a certain method, and the principal's guidance of the teachers to integrate the method into a school vision is described as central. Again, we must return to the fact that it is crucial for the successful implementation of LLS that the principal has in-depth knowledge of LLS as a method, and a firm belief that LLS holds a particularly strong potential in making a difference for teachers' instruction and students' learning and results. The principal in Zhang's case study had attended training in Lesson Study and the Community of Practice Approach before initiating the change, and the process started with one group of teachers at the school who were supported in their work with LLS, which then became exemplary for the rest of the staff. Throughout the process, the principal supported and challenged her teachers in developing the Lesson Study approach.

Concluding Remarks

In the principals' descriptions of desirable school development, many aspects emerge that chime with LLS as a method. First and foremost, school development is described by all as concerning instructional analysis. Second, development is described as a collective process where collaborative learning and support is essential. Third, the need for departing from concrete situations and for measuring the process is described as highly important and as raising teachers' awareness of the fact that instruction makes a difference. Fourth, a common language for analysing and describing instructional and learning activities is described as essential for the analysis process. All these aspects speak in favour of LLS.

A number of factors may also hinder the use of LLS. Frequent changes of principals and lack of in-depth knowledge or belief in the method may be a major obstacle. Other obstacles described by the principals themselves, applicable to school development work in general, are poor foresight and planning on behalf of principals, the fact that too many projects are going on at the same time, the fact that development work is imposed on the schools top-down, and the prevailing trend in schools in general, that any changes need to provide quick results.

The principals in the present study stress the importance of measurable results in terms of enhanced student learning, but simultaneously claim that results from LLS work are not just about being able to measure students' learning. Just as important, at least initially, is teachers' raised awareness of the need for a systematic way to scrutinize instruction, and their insight into the fact that it is actually possible to make changes that affect students' opportunity to learn.

References

- André, M. (2012). *Rektor – jobbet ingen vill ha* [Head teacher – the job nobody wants, in Swedish]. Collected 2016-01-02 <http://chef.se/rektor-jobbet-ingen-vill-ha/>
- Cheng, Y.C. (2007). Future developments of educational research in the Asia-Pacific region: paradigm shifts, reforms and practice. *Educational Research for Policy and Practice*, 6(2), 71-85.
- Davies, P. & Dunhill, R. (2008). Learning Study as a model of collaborative practice in initial teacher education. *Journal of Education for teaching*, 34(1), 3-16.
- Gardner, J., Harlen, W., Hayward, L. & Stobart, G. (2011). Engaging and Empowering teachers in Innovative Assessment Practice. I A. Berry &

- B. Adamson (Red), *Assessment Reform in Education, Policy and Practice*. Dordrecht: Springer.
- Hargreaves, A. & Fullan, M. (2012). *Professional Capital. Transforming Teaching in Every School*. New York: Teachers College Press.
- Hattie, J. (2012). *Visible learning for teachers: maximizing impact on learning*. London: Routledge.
- Hiebert, J., Gallimore, R. & Stigler, J.W. (2002). A knowledge base for the teaching profession: What would it look like and how can we get one? *Educational Researcher*, (5), 3-15.
- Hirsh, Å. & Lindberg, V. (2015). *Formativ bedömning på 2000-talet – en översikt av svensk och internationell forskning*. [21st century research on formative assessment – a review of Swedish and international research, in Swedish]. Stockholm: Vetenskapsrådet/Swedish Research Council.
- Lewis, C., Perry, R. & Murata, A. (2006). How should research contribute to instructional improvement? A case of lesson study. *Educational Researcher*, 35(3), 3–14.
- Miyakawa, T. & Winsløw, C. (2013). Developing mathematics teacher knowledge: the paradigmatic infrastructure of “open lesson” in Japan. *Journal of Math Teacher Education*, 16, 185–209.
- Swedish National Agency for Education (SNAE) (2015). *Skolverkets allmänna råd med kommentarer: Systematiskt kvalitetsarbete för skolväsendet*. [Advices and comments: Systematic quality work for schools, in Swedish]. Stockholm: Fritzes.
- Sverige (2017). *Skollagen (2010:800): med lagen om införande av skollagen (2010:801)* [Education Act, in Swedish]. (Åttonde upplagan). Stockholm: Wolters Kluwer.
- Zaccheus, U. (2013). *Täta rektorsbyten i många kommuner*. [Frequent changes of head teacher in many municipalities, in Swedish]. Collected 2016-01-02 <http://www.svt.se/nyheter/inrikes/tata-rektorsbyten-i-manga-kommuner>.
- Zhang, Y. (2015). Sustaining Lesson Study in schools with positive peer leadership. *International Journal for Lesson and Learning Studies*, 4(2), 140-154.

CHAPTER 10

Teacher Owned School Development – Possibilities and Constraints

Inger Eriksson & Kalafunja Osaki

Today school development with a foci on teaching has gained momentum worldwide following earlier focus on raising school scores on achievement tests, improving school inspection and supervision, initiating programs aimed at school improvement and similar projects that aimed to raise the quality of teaching and learning at school level. There is also a growing expectation that teaching is to be based on and developed in relation to educational research findings or knowledge. This implies that the knowledge needed already exists and only needs to reach out to schools and teachers. This understanding casts teachers as implementers of knowledge. An explanation to schools which fail to improve their teaching and students' learning – still often measured by the amount of students passing exams and tests – is thus that teachers either do not know about the research findings or resist using new knowledge from available research. The problem is thereby related to the teachers' lack of knowledge, interest or seriousness.

During the last decades this type of understanding of the problems has been questioned and an alternative evolving understanding is that the dominating university based educational research perhaps does not always heed sufficiently the demands that teachers encounter in their everyday work – especially when it comes to issues of subject-specific character. Further, teachers' participation in the process of developing

knowledge needed has been addressed by several researchers and can be connected to the movement “teacher as researchers” (Cochran-Smith & Lytle, 2009). Carlgren (2012:3) connects the tradition of “teacher as researcher” to action research, but also to Dewey’s notion of teachers as both consumers and producers of knowledge (Seals, 2004). Schön’s (1983) idea of reflection-in-action as a practical epistemological approach to knowledge building is another related line of research, as well as Shulman’s (2004) ideas of explicating teachers’ pedagogical content knowledge. In relation to this, teachers are not only seen as key participants in research but their experiences and knowledge of students and other aspects of the practice are seen as necessary conditions if a subject-specific knowledge of relevance is to be developed (Bulterman Bos, 2008, 2017; Carlgren, 2012).

The need for a research process that takes the issues and demands arising in the classroom when trying to facilitate students learning in different subjects is thus coming more and more into focus as connected to issues of school development. There is, however, not a simple way to realize school development that can be addressed as teacher owned.

An issue related to this is that of teachers’ research competences. Many teachers are not educated well enough to conduct research in relation to their everyday work. Even if teacher education, as in Sweden, includes scientific methods and scientific papers or theses, few have done developmental research in relation to their everyday teaching challenges. Further, models such as Lesson and Learning Study (LLS) require special methodological competencies. In other countries, as in Tanzania, the teachers are even less trained to conduct or participate in this type of developmental research. Thus, considering teachers’ developmental research competences, teacher owned school development in many schools will benefit from, or need, collaboration with researchers. In future, schools and centres may have more research-educated teachers but until then collaboration with university-based researchers is a possible way to handle the problem. That is how the research project reported in this book was designed.

This chapter addresses some possibilities and constrains when trying to establish a teacher owned research based school development using LLS supported by researchers.

Features of Teacher Owned School Development

There are at least six main features of teacher owned school development that aims to develop subject-specific knowledge on teaching and learning.

- First, teacher owned school development focuses on improving teaching to enhance students' learning rather than mere improvement of the resource base, infrastructure or raising test scores alone;
- Second, teachers' experience of what are seen as problems in teaching and learning is taken as a starting point when deciding what knowledge is to be developed, hence moving towards a clinical level where research tests various learning possibilities focusing on specified objects of learning, variation of learners, and learning experiences (Bulterman Bos, 2008, 2017; Carlgren, 2012);
- Third, school development research has mainly emerged from the design research paradigm based in universities aimed at designing and testing new designs of content organization and pedagogical orientations described in, for example, the work of Van den Akker, et al. (2006), Plomp (2007) and others. It is iterative, practitioner based, and oriented towards process, utility and theory building at the classroom level. Further it is based on collaborative work of researchers and practitioners just like clinicians in hospitals collaborate with biomedical researchers based at the university level to develop joint solutions to medical problems (Bulterman Bos, 2008);
- Fourth, this type of research builds both practical ideas and theoretical concepts that can improve students' learning directly in specific situations and give teachers confidence to continue this process;
- Fifth, models such as LLS do not strive for generalization in statistical sense but aim at a theoretical insight for understanding particular cases of classroom experience. LLS is, hence, a model for improving clinical educational practice by generating knowledge related to teachers' professional tasks and objects in a dynamic, interpretive and meaning making sense;
- Sixth, collective professional knowledge can, therefore, emerge from this local route to school development.

In the context of the two education systems, that of Tanzania and Sweden, we can find that due to variation in the stage of socio-economic

development, there are differences in the entry points of teachers in the process of school development.

In Tanzania, a developing country, school development is still viewed in terms of improved infrastructure, provision of textbooks and furniture and later the raising of student scores in subjects such as Mathematics, Science and Language. As mentioned, most teachers at the primary school level are secondary school graduates who do not have very high content mastery and who have gone through short teacher education programs that have not developed a deep understanding of teaching as a profession. Educational administrators and managers still treat teachers as technicians and regularly send orders for them to implement, guided by a prescriptive curriculum, with highly structured syllabuses and monitored by school inspectors and an externally set examination. Where research knowledge is used to make decisions in the classroom, this is generated by people within the higher education sector and is transmitted to teachers through different in-service education and training programs that until recently were not even school based.

In Sweden all teachers are educated on an academic level and have in their exam subject-specific knowledge that exceeds their upper secondary education required as a base for teacher education (see chapter 4). But as mentioned above the knowledge base that Swedish teachers are trained in relation to teaching does not always match the problems that arise in the classroom concerning students' learning. The Swedish teachers can on one hand be regarded as well educated but on the other hand, still meet educational reforms in which they are mostly seen as implementers (or learners). Further, during the last decade large-scale in-service educational programmes have been launched. The Swedish teachers still work in a culture where their role in school development is not always obvious. Thus, even if the Swedish teachers are much better educated concerning, for example, research methods, compared to Tanzanian teachers, and even if quite a few have been working with models such as LLS to improve their teaching the need for collaboration with researchers will continue to be the case for several years to come. Still we think it is appropriate to talk about teacher-owned school development and practice-based developmental research.

This project, thus, attempted to make it possible for teachers in collaboration with researchers to participate in generating the research problem and the object of learning, and to be an active part in the work of trying out solutions to the pedagogical problem of their choice. We have

gained some pedagogically useful knowledge through the cases that the participating teachers feel proud to be part of and which is disseminated in this book and it hopefully has the potential to contribute to some subject-specific learning process in the classrooms of other teachers.

In the following, we want to address some issues that need to be considered when organising for teacher owned school development. Firstly, we will argue for the need for collaboration with researchers and, secondly, the need for support from the school leaders.

Collaboration with Researchers as a Necessary Condition for Teacher Owned, Subject-specific School Development

Three of the parallel cases, in Science, English as second language and Mathematics, are described as cases of Learning Study. The two cases related to cookery: in Tanzania – how to make bread, and in Sweden – how to use proper utensils in a proper manner are described as cases of Lesson Study. As pointed out in Chapter 2 it is not easy to separate these two models or research approaches from each other. As Carlgren claims (Chapter 2) the main difference is the use of a learning theory, the focus on an object of learning and its critical aspects in a Learning Study, while in Lesson Study the focus is mostly on the development and teaching of the lesson as a whole.

Despite it not being possible to describe all cases as a Learning Study, all of them used the two central concepts of a Learning Study: objects of learning and critical aspects. In all cases the choice of the object of learning involved the teachers in the respective schools. In Tanzania, the researchers perhaps had a larger influence than did the Swedish researchers. Choosing a topic that the teacher could identify as demanding was not difficult in any of the cases. The teachers in Tanzania discussed demands in relation to the chosen subject together with the researchers and could easily define one or two problematic topics. The researchers then supported the teachers when specifying the object of learning. In Sweden the teachers almost independently could point out difficult topics and more or less independently suggested a preliminary object of learning supported by their mentor respectively.

To formulate and specify the object of learning was not as easy as defining a problematic topic. The delimitation and specification of an object of learning is one of the more demanding tasks in a Learning Study. In relation to this work the collaboration with the researcher was of importance since this process demands both theoretical subject knowledge and knowledge of how to construct and analyse a pre-test.

As a tool we decided that all objects of learning should be formulated through a sentence starting like the following: The students should be able to ...

Some of the problems when identifying the object of learning are connected to teachers habit of thinking in terms of what topic to teach about, not in terms of what students need to learn; what ability they need to develop right now. Most teachers often think in terms of a broader topic area to be covered during a specific period, and thus, not in terms of a single lesson. Further, planning for a topic is often informed by the content described in the curriculum or in a textbook. Further, when identifying an object of learning it is not enough to only consider the content. The students' actual knowing must also be taken into account as well as the desired ability (see Chapter 2). Thus, in the pre-test, mapping of students' knowing is of importance if the identification of the object of learning is to be relevant for the group. In Chapter 3 some of the problems with pre-testing are illuminated in relation to earlier Learning Studies. The object of learning needs to be considered as both relational and dynamic and the identification process is enhanced by the combination of teachers' and researchers' complementary competences. Some of the cases reported here also give examples of how the object of learning is developed throughout the study.

The two English as second language cases give examples of how the object of learning was developed or could have been developed. The Tanzanian English case was based on the result from a pre-test with the object of learning chosen: *the students need to understand the concept of reported speech*. Through the iterative process and after the third lesson the authors concluded that if they were to do a fourth lesson they would change the object of learning to: *the students' ability to change from first person to third person when changing from direct to indirect speech*. That would have been a more precise object of learning. In the Swedish English case the object of learning changed rather radically during the iterative process. From stating that *the students need to be able to use strategies efficiently* to *the students' ability to tell a story based on a series of pictures*. Due to the group's understanding of strategies – from being the content of the object of learning to become the means for producing stories and thus realising another object of learning. In these two cases both the iterative process in combination with the teachers' and the researchers' experiences were necessary conditions. Also in the two cases of Mathematics the object of learning was developed through the

iterative process in such a way that what the students needed to learn, become more precise.

The collaboration with researchers is also of importance when analysing the pre-tests and the lessons in order to identify relevant critical aspects as the next step in the process. There are as many problems identifying them as identifying the object of learning. Here, again, the teachers' experiences of what is difficult for the students to learn are of significant value since it may be taken as a basis to be transformed into tentative critical aspects. Understanding that critical aspects are aspects that students need to discern, to understand, to grasp, is therefore important. Critical aspects, if they are relevant, will support teachers through the iterative process in developing knowledge of exactly what the students need to learn. In the project we recommended each researcher-teacher group should explicitly construct the critical aspects with a sentence starting like the following: The students need to discern ... (grasp, understand, handle). Further, identifying critical aspects requires an analytical stance when calibrating them during the whole Learning Study process.

The use of a learning theory – theory of variation – as a design and analytical tool is also demanding and can be enhanced by collaboration with researchers. In the three parallel cases considered as Learning Studies (Science, English, Mathematics) the theory of variation was used. However, using as complex a theory as theory of variation is demanding in any Learning Study. In many Learning Studies researchers' most important role is related to the use of a learning theory. When designing a lesson with the help of the theory the efficiency depends on the understanding of the theory but also on how well defined the identified critical aspects are. In a temporary project such as ours it was necessary to rely on the researchers understanding of the theory, especially in Tanzania. In one of the Swedish cases the teachers had worked with the theory before. Using the theory of variation, if we want to keep it simple, there is a need to decide what to keep constant and what to vary, for example, when presenting the content to the students (in tasks or in the communicative situation). Further, using the theory in the research lessons also demands that the teachers on the spot can follow students' arguments, answers or understanding in order to use the dimension of variation that in an unplanned way can occur. This requires a teacher's trained "eye". When planning the lesson the researchers and the teachers can carefully outline the dimensions of variation to be used. When the lesson is enacted the planned variations may not work out as planned or

the students' inputs may blur the planned critical aspect to be discerned. In a Learning Study conducted as a research project this type of problem may be a source for the iteration of development. The different cases give some ideas of how to use the theory of variation.

In the two cases that we have categorized as Lesson Studies the object of learning was rather broad and focused more on the design of a lesson than specific content to be discerned. In the Tanzanian case, three objects of learning were decided on during the lesson: Students were supposed to be able to

- To mix water and flour in order to make dough to the right standard
- To set up, equip and manage the local oven
- Prepare bread for family use or for sale

Each of these three objects of learning would in a Learning Study have been too broad and to imprecise. However, as a Lesson Study, the lesson plan worked out in collaboration between the researchers and the teachers provided the students with experiences of a kind that related to the curriculum. Further, from a Tanzanian perspective the lesson allowed the teachers to experience how to create a teaching situation where the students could work in groups and produce a product. Given a class of 100 students, practical work such as baking or designing group work is not what teachers do on a regular basis. The focus, and the knowledge developed, was on one hand on how to organise a huge group of students and on the other how to overcome the material limitations. The idea of a homemade oven was brought to the teachers by the researchers. The teacher-researcher collaboration was necessary and the outcome was surprisingly good. In Sweden the case of Home and Consumer Studies also turned out as a Lesson Study, mostly due to the chosen object of learning: *to be able to choose and use kitchen utensils related to specific techniques, for a vegetable soup*. This object of learning also contains three or more possible objects of learning. This Lesson Study in contrast to the Tanzanian case is understandable only in relation to the very well equipped school kitchens. Further, the chosen content was also in line with the national curriculum. The teacher and mentoring researchers discussed possibilities to find a more precise object of learning but from the teachers' point of view they wanted to explore how to organise for this type of knowing.

The Role of School Leaders in Teacher Owned School Development

Throughout all the eight cases the issue of the school leaders', or principals', role was discussed. In Tanzania the researchers had direct contact with the school leaders and there were few or no problems in arranging for the cases to be conducted from their perspective. In some of the cases, the principal also participated actively. It would not have been possible for the researchers to contact a group of teachers and to conduct the project without the school leaders' approval or interest. However, the Tanzanian cases depended heavily on the researchers; they also depended heavily on the school leaders. In some of the schools the school leader gave the teachers the task to cooperate with the researchers while in others the teacher was asked if they wanted to participate. In Tanzania we can conclude that the school leader at a local school has the mandate and the power to promote teacher owned school development. It is up to her/him to decide. Thus, there is still a change needed if teachers themselves are to be active agents in local school development. The teacher education process may play a role in preparing teachers for such a change, but also the mind-set at school level needs to evolve in the direction of allowing teachers to be innovative and creative.

In Sweden the researchers first contacted the teachers and only after having the teachers' agreement that they were interested in participating in the project, were the school leaders contacted to ensure that the teacher was given time to participate. However, all the cases depended on the school leaders' approval to get the time needed. The school leader could have stopped the project or could have signalled that s/he did not find it appropriate. In one of the schools the school leader said that this type of project take too long time and that other developmental project will be set aside. This gives an idea of how vulnerable teacher owned school development can be. On the other hand, it would have been almost impossible for the school leader to impose such a project upon the teachers. Thus, from that point of view the teachers have developed a kind of ownership. Still, they are dependent on the school leaders' support and approval.

Based on our experiences, teacher owned school development – a development that focuses on students' subject-specific learning – in both countries depends on collaborations, time, support for a productive model. Further, if we want to promote teacher owned school development there is a need to include research and developmental

models such as Lesson and Learning Studies into the teacher education or into in-service training. We have tested Lesson and Learning Study as models and we find them to be useful and possible to introduce in schools regardless of contextual aspects. We believe that our readers, mainly school teachers, teacher-educators, educational researchers, curriculum designers, evaluators and school leaders will find this text useful as we all struggle to make learning more meaningful in our education systems.

References

- Bulterman Bos, J.A. (2008). Will a Clinical Approach Make Education Research More Relevant for Practice? *Educational Researcher*, (7), 412. doi:10.3102/0013189X08325555.
- Bulterman-Bos, J. (2017). How Can a Clinical Research Approach Contribute to Knowledge-Building for the Teaching Profession? *Educational Action Research*, 25(1), 119-127.
- Carlgren, I. (2012). The learning study as an approach for 'clinical' subject matter didactic research. *International Journal for Lesson and Learning Studies*, 1(2), 1-18.

School Development through Teacher Research – Lesson and Learning Studies in Sweden and Tanzania presents the results from a three-year-long joint research project conducted by educational researchers from Tanzania and Sweden. Even though the country contexts differ in social, economic as well as educational conditions, including teacher education and classroom standards, many recurrent education challenges are shared. These include the tendency to make educational reforms with little or no input from professionals. The new educational reforms in both countries put a much higher responsibility on teachers; teachers must be able to organise teaching that enables all students to develop required abilities/competencies. Thus, teachers need tools to develop knowledge that can contribute to their professional knowledge base. With an overall interest in issues of teaching and action research, this joint project aimed to use Lesson and Learning Study as models for developing and improving the quality of teaching and learning in schools. The research project was realised through four case studies in each country with a focus on students' development of specific capabilities and values Science, Vocational Skills/Home and Consumer Studies, English as second language and Mathematics in grades 6-7. Complementing the cases *School Development through Teacher Research – Lesson and Learning Studies* in Sweden and Tanzania offers an introductory background to Lesson and Learning Studies as models for teacher-driven research and school development.

The book is written to support teachers and teacher educators' wishing to reflect about learning and the struggle of learners to discern various concepts, principles and practices. As well as those who genuinely wish to see serious learning take place, rather than simply seeing content 'covered' – including curriculum designers and developers, educational researchers, educational supervisors and leaders and student-teachers as well as students of pedagogy and didactics. We dedicate the book to teacher educators, teachers and school leaders who are seriously striving to enhance students' learning and understanding in different subject areas.



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